

December 28, 1959

SPECIAL REPORTS:

Republic F-105

Yakovlev Details

Yak-24 Program

# Aviation Week

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Republic F-105 Thunderchiefs

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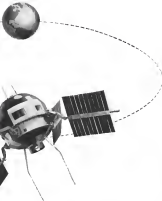




## Laurels for 1959

**Explorer VI  
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paddles  
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sunlight  
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The scientific data that will some day enable us to probe successfully to the very fringes of the universe is being recorded and transmitted at this moment by the space laboratory Explorer VI, a satellite now in orbit around the earth. This project, carried out by Space Technology Laboratories for the National Aeronautics and Space Administration under the direction of the Air Force Ballistic Missile Division, will advance man's knowledge of the earth and the solar system. The magnetic field strengths in space. The cosmic ray intensities away from earth. And, The micrometeorite density encountered in inter-planetary travel. Explorer VI is the most sensitive and unique achievement ever launched into space. The \$9 million, STL designed and instrumented by STL in cooperation with the university, will remain "viewed" for its anticipated one-year life.



How? Because Explorer VI's 132 pounds of electronic components are powered by storage batteries kept charged by the impingement of solar radiation on 8,600 cells in the four sails or paddles equivalent to 19.5 square feet in area. Many more of the scientific and technological miracles of Explorer VI will be reported to the world as it continues its epic flight. The STL technical staff brings to this space research the same talents which have provided systems engineering and overall direction since 1954 to the Air Force Missile Division, and the Pioneer 1 space probe.

Important staff positions in connection with these activities are now available for scientists and engineers with outstanding capabilities in propulsion, electronics, thermodynamics, aerodynamics, structures, astrophysics, computer technology, and other related fields and disciplines.

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**Space Technology**

**Laboratories, Inc.**

We have not only reached the end of another remarkable year in aviation and its related technologies but also the end of a decade that may well be labeled the "Isolation Effect" from its record of technical development and the "Isolation Effect" from its record of policy bewilderment, executive indecision and the confusion among even a complacency that accepted the idea that the United States could dip to second best in technology without endangering its leadership of the free world. New political leadership is inevitable in the decade that looms ahead, regardless of which party wins the national election of next fall, and new policies are bound to result.

This year, like 1958, would find that a lot of "guts" who have slowed the wheels of progress probably would be longer and more appropriate for the times than a mental of the conservative achievements in our field. However, here are the people, organizations and equipment we think have made significant contributions to American aviation and its related technologies through 1959:

- **Convair's San Diego Division** and USAF Maj. Joe Rogers for bringing the world speed record back to the United States with a 1,523 mph performance in a standard F-106 Mach 2 all-weather interceptor.
- **Lockheed Aircraft Corp.** and USAF Capt. Joe Jordan for setting a new world altitude record of 103,995 ft in an F-104C interceptor.
- **Republic Aviation Corp.** and USAF Brig. Gen. Joe Moore for returning the 100 km. closed course record to the U.S. with an F-103B averaging 1,216 mph over the course.
- **Ray, Gen. Homer Bonney**, USAF director of advanced technologies, for his persistent, articulate and courageous exposition of a military space program.
- **Rear Adm. John S. "Jimmy" Thach** for his effective effort to organize a broad technical military attack on the subterranean warfare problem and his leadership of Navy ASW forces in the Atlantic.
- **Man Conrad** for his persistent demonstration of the long-range reliability capability of U.S. manufacturers of business aircraft, engines and navigation equipment.
- **Allegiance Airlines** and its President Les Barnes for its pioneering program aimed at developing generic air carrier service.
- **Col. Hans J. Moseley**, chief of the Aeronautical Safety Division for the USAF Inspector General, for his work in design and retrofit of operational aircraft to reduce crew injuries to accidents, particularly in cutting the fatality rate in use of ejection equipment. Col. Moseley was killed in an aircraft accident this year.
- **Sen. John Stennis**, chairman of the NASA authorization subcommittee of the Senate Aeronautical and Space

Services Committee, and **Max Lehner**, assistant director of the committee staff, for their planning and execution of the public hearings on the first National Aeronautics and Space Administration program.

- **Gen. Thomas S. Power**, chief of Strategic Air Command, for his valiant efforts to keep the U.S. deterrent power at the maximum possible efficiency with the limited resources placed at his disposal and his persistent efforts to accurately inform the American people on their defense problems.
- **Charles Thomas**, president of Trans World Airlines for galvanizing this airline's employees into an amazing leap from deep in the red to well into the black in the initial year of his presidency.
- **Convair's Astronautics Division**, particularly its chief "Jim" Druggan, plan "Charles" Bessant, "Charles" Ams and "Bill" Patterson, for bringing the Atlas ICBM to fruition as a reliable, accurate and significant weapon in the U.S. arsenal. Atlas made its 13th consecutive successful full range flight in December.
- **Boeing Airplane Co.** and the seven airlines who operated the 707 turbojet transport in regular service this year carrying a total of 1,725,000 passengers and flying 3.3 billion passenger miles in scheduled service without a passenger injury.
- **Alan Sikorski** for his personal contribution in his 71st year to the development of the S-60 and S-61 flying crane concept for helicopters.
- **Pan American World Airways** for its inauguration of round-the-world service by turbojet transport with a regular scheduled flying time of 37 hr. 45 min.
- **Jacques Cochran**, president of the Federation Aeronautique Internationale (FAI), and **Thomas Loughery, Jr.**, president of the National Aeronautics Association, for their organization and leadership of the American delegation to the FAI conference in Moscow.
- **Arthur Kelley**, vice president-sales for Western Air Lines for one of the most imaginative and forward-looking airline sales programs designed for making jet age problems.
- **The dozens of aerospace firms** who by "shaking rattle" pioneered new, electronic and electro-mechanical techniques that promise to revolutionize the aviation field and have particularly promising applications in space technology.
- **Edward R. "Pete" Quasada**, Federal Aviation Agency chief, for his vigorous leadership of this new agency and its broad scale attack on the major problems of civil aviation.
- **Rockwell Division of North American Aviation, Inc.**, for its consistent performance in providing powerplants of high reliability for both U.S. ICBMs, the Atlas ICBM and the Atlas, Thor and Juno space probes.

—Robert Hots

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## WHO'S WHERE

### In the Front Office

**Jim Oremont,** board chairman, Fox Motor Film Corp., Los Angeles. Cited by Dan S. MacLean, chief executive of the office and a director. Alan D. Greenwald has resigned as president but will remain available to the company as a consultant.

**Walter Stenberg,** a director and a member of the executive committee of South Pacific Air Lines, and Sam Wilson, vice president and chief of operations. Mr. Stenberg formerly was senior vice president of National Airlines and Mr. Wilson, executive vice president for Transwest Air Lines.

**Frank B. Lewis, Jr.,** president, Visa Corporation of America, New York, N.Y., succeeding J. Gordon Ward, Jr., who has been named board chairman. Charles S. Peters, retiring board chairman, has been elected chairman of the directors executive committee.

**Dr. A. B. Van Rensselaer,** vice president and director of the Technical Division, United Research, Inc., Cambridge, Mass.

**Richard D. Harbison,** vice president and a director, Rothco, Inc., Glendale, Calif. Also, Benjamin N. Chasman, production manager.

**Rex Allen, Mel A. Peterson** (USN, ret.) executive vice president and a director, Belvoir Research & Development Laboratories, Inc., Woodside, N.Y.

**John T. Kane,** vice president and treasurer, Los Angeles Airways, Inc., Van Nuys, Calif., replacing as president in the president, Fred W. Miles vice president, Intertec.

**Rex Allen, Frederick J. Bell** (USN, ret.) vice president, Washington, D.C., after Fox General Telephone & Electronics Corp.

**H. F. Kiggins, Jr.,** who is director vice president, also appointed as senior general manager, Radioactive Division of Northrup Corp., Van Nuys, Calif.

**Bernie Dink,** special assistant for defense in the Office of the Director of Defense Research and Engineering, Washington, D.C. Also, Albert W. Blackham, special assistant to the assistant director of defense research and engineering for strategic support.

**Wesley L. Hymowitz,** deputy director of business administration for the National Aeronautics and Space Administration, Washington, D.C.

**Rex Allen, William A. Scherf** (ret.) commander, First Air, Western Pacific Airlines, San Jose, Calif. Also, William M. Kuttin, Rex Allen, Rex C. Northrup will report Allen Scherf as commander, Carson Division Two.

### Honors and Elections

**Howard Cary,** a director, Nymex Associates, Palo Alto, Calif., will be in possession of Applied Physics Corp.

**Francis M. McDermott** has been named executive director of the Air Traffic Control Act, Washington, D.C.

**William J. Rogers,** executive vice president, General and planner for American Airlines, has been named chairman of the company's finance committee.

(Continued on page 87)

## INDUSTRY OBSERVER

► Wright Air Development Division is expected to tell Douglas Aircraft Co. next month to initiate research and development of the GAM-87A or launched ballistic missile, following Defense Department approval. Funding for this phase now runs as high as \$125 million. Douglas' actual start, contract now extends to March.

► Air Force is considering both television and infrared scanning techniques for general security surveillance of areas surrounding the unattended site launch sites for the Minuteman ICBM.

► Proposals for mechanical conversion scheme for SNAP 8 nuclear turbo electric power generation system are scheduled to be submitted to National Aeronautics and Space Administration early in January. Contract for reactor, nuclear Atomic Energy Commission equipment, probably will be awarded to North American Aviation Atomic International Division.

► Air Force plans to outfit the Boeing B-52H with existing electronic countermeasures equipment following recent decision to stop production of the AN/ALQ-27 ECM system at Sperry Gyroscopic Co. (AW Dec. 21, p. 18). AN/ALQ-27 represented the first and only system approach to theater countermeasures in which the ECM operator would have a variety of techniques and his weapons to counter unexpected situations. With its cancellation, USAF will revert to its former "black box" approach in which the selection of ECM equipment turned on each mission is largely tailored to the mission.

► Douglas Aircraft Co. proposal to Air Force for employment of the Thor intermediate range ballistic missile plus other staging in ICBM cells for use of variable propellants. Vehicle has been designated S900.

► Development studies and projections for support and operation of WS-117L. Some satellite optical reconnaissance phase and MDA infrared early warning capability are being reviewed by Air Force headquarters to define the timetable for critical factors for these satellite capabilities.

► General Electric Y93 turbojet engine for the North American B-70 probably will be developed without the refinements of weight and projected efficiency originally planned, although it is likely that the original date for first start operation of the engine in the spring of 1961 will be adhered to, despite acceleration of the B-70 program.

► Growing number of electronic support systems involving automatic data processing and display has prompted Air Force to study possibility of combining one or more of these. Several teams of technical specialists will be formed shortly by Air Research and Development Command to meet operational requirements established for the 1955-75 period and determine how they can meet effectively and economically be met. Results of the study are expected by late spring or early summer. Systems continue to be considered include Strategic Air Command Control System (4054), Naval Combat Operation Center (4054), Air Force Control System (4754-L), Intelligence Data Handling System (485-L) and Electronic Support Intelligence System (4654-L).

► North American will probably eliminate the large door brake on the left of the Navy A-1J in production models. Prototype flight tests indicate the wing spoiler-brake system provides effective short field performance.

► International Telephone & Telegraph Corp. Industrial Products Division and Electronic Communications, Inc., Air Associates Division are considering a joint venture for expanded participation in supplying wireless products for lightplane and business flying markets.

► Grumman F11F-1F Super Tiger jet being considered with the Saab 3700 Sab 3700 and French Dassault Mirage 5 for the fighter role in the So on as first in equipment program, and the Fiat CR 91 as earlier reported (AW Dec. 31, p. 25).



## MISSILE GUIDANCE OUTPOST.....

The Radar Course Directing Console designed and produced by Stavid for the REGULUS missile provides the Navy a means of positioning transmitters utilizing power against targets to provide necessary information on operational air capable of circumventing the missile's in-flight and provide missile crews with an accurate prediction of bearing and range information through declassification and course correction.

Stavid's electronic capability is strikingly demonstrated in this task which required design and manufacturing skills ranging from the atomics to the computer—all developed and produced within our facilities.

The Stavid capability ranges from original research to system redesign for mechanical producers. Recent accomplishments include:

- Gun Fire Control System Mark 12
- Radar Console for X-20 Aircraft
- Radar Teletype System

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Outstanding expertise and resources are needed to require into opportunities on Stavid's advanced systems engineering team.



David Nelson, Engineer, Lockheed Electronics, Inc. is general supervisor in electronic development, including present direction of guidance systems, electronic simulators and fire controls.

### Promotion Directive

Future promotion of career officers to one of the general or flag ranks will be tied to past service as a staff officer combined in actual command in effect staff and under stress of a new directive issued by Defense Secretary Thomas S. Gates, Jr. The directive, designed to lessen staff service reality and provide top-level officers who have demonstrated an ability to deal effectively with other nations, is similar to a plan previously recommended by the President. The President's plan, however, called such service desirable rather than mandatory and suggested that it should be applied to promotions above a one-star rank.

### Comptroller General Complaint

Comptroller General Joseph Campbell complained last week that Defense Department has refused to turn over two secret reports that would help in analyzing the military assistance program (see p. 20) in a letter to Rep. W. L. Donnan (D-RI), House Government Operations Committee chairman. The two reports involved U.S. European Command recommendations to the Joint Chiefs of Staff on the size of Allied forces that should be supported during Fiscal 1960 and an evaluation of French military plans and capabilities made by a U.S. military mission. Campbell told Donnan that General Accounting Office wants the reports to help determine whether the military aid program is being used promptly to reflect changes in foreign requirements.

The GAO also reported last week that the President in a letter to the Comptroller General, refused to turn over reports on the handling of disarmament, Cooperation, Administration and in Iran and Thailand because, he said, release of the reports would not be compatible with national interest. In a separate report to Congress, GAO accused the Navy of changing facts to the authorized press for certain material furnished under the military assistance program.

### USAF Waste Charges

In another report, GAO also charged that the Air Force is wasting approximately \$3 million a year in repairing dilapidated automobiles rather than having off-credit new ones. In a report to Congress recommending that Air Force make a thorough study of its vehicle replacement program, GAO said:

In the last three years the Air Force has incurred an estimated \$5 million more in repair costs and depreciation and market value on old vehicles than it would have cost on combined repair and depreciation for new vehicles to replace them.

Postponing the purchase of replacements for old vehicles has cost the Air Force an estimated \$3 million more because of the increase in vehicle prices. In addition, about \$2 million will be spent unnecessarily for maintenance payments each year for the next several years because of the inadequacy of the language program for replacing vehicles.

### Accident Investigation

The military subcommittee of the Senate Commerce Committee headed by Sen. A. S. Mike Mansfield (D-GA) has scheduled an investigation of commercial

airline crashes as its first order of business in the new session of Congress. Hearings are scheduled to begin Jan. 11. Considering that the accident record in 1959 has been "one of the worst in recent years," Mansfield said.

Reports received from the Civil Aviation Board ... do not show an apparent pattern as to their cause. Nevertheless, it is important that every effort be made to determine what steps can be taken to prevent their recurrence.

Later, the subcommittee plans to consider airplane reorganization, pilot certification and military participation in Federal Aviation Agency.

An Air Line Pilots Assn. also is expected to protest FAA's records, as posed 50-year-old aviation retirement age for pilots (AW Dec. 7, p. 45, Dec. 23, p. 27) during subcommittee hearings.

### MATS Rebuff

Military efforts to obtain direct delivery of air cargo to foreign bases fail to crack the technical deadlock of the Civil Aeronautics Board last week. Applications by both Trans World Airlines and Seaboard & Western Airlines to land cargo shipments at Tempco air base in Spain were rejected by the CAB. The airlines had pointed out that new MATS policy required such direct delivery as opposed to past system of landing at Madrid and trucking across the 14 mi. to the military base. Board members based their rejection of the carrier's requests on grounds that TWA already serves Tempco through Madrid. They also cited an earlier request by Seaboard to provide direct service to the military base which was denied. The Board said that the Defense Department had not indicated a need for service to Tempco and that neither airline presented enough facts to justify its request.

### U. S.-USSR Helicopter Negotiations

Soviet Embassy reports it is awaiting the arrival of technicians to advise on contract stipulations for the possible purchase of U. S. helicopters—probably two Sikorski HO4S and one Vertol Model 44 (AW Nov. 23, p. 25). The indication will leave Moscow in sums as they are granted U. S. visas, according to Vladimir Alderson, Soviet military counselor at the Soviet Embassy in Washington.

### Southeastern Local Service Awards

Southern Airlines received a majority of new local awards granted by the Civil Aeronautics Board last week in the Southeastern Area Local Service Area. Beyond new award to intermediate points on the carrier's system, Southern was permitted to extend its service into New Orleans from Memphis, Tuscaloosa, Ala. and Panama City, Fla. Northern Airlines and Delta Air Lines, both based in Atlanta, also were awarded awards to intermediate points between Jacksonville and Orlando and between Orlando and Tallahassee. In addition to providing service between Orlando and Tallahassee.

—Washington staff







**NEGATIVE** detail of the wing track, fuselage section and small frontal area of the landing gear fittings and engines are shown in this front view of the Antonov An-10A at Andrews AFB, Md.

## Improved Version of An-10 Flies to U.S.

Washington—First visit of the Soviet Antonov An-10A turbine-powered transport to the U. S. was made earlier this month as being a personal Christmas gift of 41 men and women from Soviet Premier Nikita Khrushchev to President Eisenhower. The An-10A, which landed at nearby Andrews AFB, is an improvement of the Antonov An-10 Ukraina which has driven engineers from the Russian press for entering commercial service behind schedule. According to

the official Red Air Force newspaper, Sovetskaya Aviatstsia, the delay was due primarily to technical problems. Evidence of this is that the An-10A has large vertical fins on the tips of the horizontal tail, and the wing tips have a pronounced negative dihedral, while the original Ukraina did not have these features. The dorsal and ventral fins shown have been part of the design, however.

Purpose of the An-10 series is to

provide a large load-carrying aircraft that can operate out of dirt and grass fields. Many national requirements were for quick convertibility between passenger and cargo configurations and for convenient operation with both types of runway. Cost of construction was kept down by the O. K. Antonov Design Bureau by making extensive use of assemblies, parts, hardware and equipment from existing Soviet aircraft. Latest version of the Ukraina, larger than the An-10A, is still in the planning stage. It is designated the An-16.

Differences between the An-10 and the An-10A include an increase of seats from 81 to 100 in an almost-cabin arrangement, switch from Kuznetsov to Dvukhkor engine, half of approx. 4,000 hp and a new, more modernizing engine installation.

Cockpit layout of the An-10A is similar to that of the Tupolev Tu-114. Navigation aids in glasscockpit used by the radio operator is behind and below the cockpit. The two pilots sit about five feet above a walkway between their seats. Switching seat between the pilots and over the walkway allows the flight engineer to assist them and swing around to monitor other instrument panels to the rear.

Flight of the An-10A to the U. S. included a scheduled stop in Glasgow, Newfoundland, and an unscheduled landing in Boston because of bad weather in Washington. The aircraft's return trip apparently was made with an eye toward "showing the flag." Its flight plan listed stops in Gander, Keflavik, Iceland, and Presburg, Scotland. Inventory of the trip by Paul Presburg was to be given the crew after it arrived in Scotland.



**SECTIONAL** stability problems encountered with the Ukraina series is indicated by the addition of large vertical surfaces on the tips of horizontal tail on the An-10A. The dorsal and ventral fins were on the An-10.



**INTERIOR** of An-10A flown to U. S. (left) has 81 but 100 seats and all its seating covered. Wall and ceiling furnishings are stretched for passenger use. Four padded sections against the wall support galleys built. Long strips with tie-downs, cargo attached near the ceiling into bins to secure cargo load. Wing runs through structure protrudes slightly into the cabin ceiling. Passenger seats (right) have individual lights mounted on headrest. Three buttons on arm of each seat allow the passenger to tilt the seatback on, lock to raise with a small hydraulic and operate the reading light. Mirrors also are shown on the forward bulkhead.



**SHORT**, simple landing gear installation on the An-10A (left) has low pressure tires and is designed especially for dirt and grass field operations. Main landing gear on the An-10A (right) struts into a wall under the floor, leaving the passenger/cargo compartment free of obstruction. Arrangement also keeps wheels within the fuselage lines and allows a smaller fuselage covering the gear attachment point.



**INCURRED** \$400 by plus subsequent repairs on the An-10A are the same as those used on the Tu-114 Moscow transport. The early An-10 Ukraina had Kuznetsov turbine engines of approximately the same power. High wing arrangement reduces the amount of dirt and det. Blocks up during operation from unpaved fields.

# Increased Military Aid Support Planned

By Fred Ertman

**Washington**—With the backing of military assistance funds nearly gone, more money for the Military Assistance Program will be urged by the Administration when Congress returns next month.

Contributors of the present need in which expenditures greatly exceed as much appropriations will soon lead to deterioration of the nation's forward defense posture. These new changes in the present military strategy and alliance center, Administration officials contend.

For the last seven years, expenditures to meet minimum requirements have been from \$400 million to more than \$1 billion higher than the amounts appropriated. The difference have been made up by drawing from a pipeline of unexpended balances created by big appropriations and low expenditures during the early part of the program.

However, the situation now has reached a critical point where the future role of military aid will depend upon the course of action to be taken during the coming year.

Because of the long, steady drain on the pipeline, carryover funds have dwindled from \$4.4 billion in 1953 to an estimated \$2 billion at the end of Fiscal 1960. According to Defense Department budgetary officials, the deficit, which is below the minimum amount needed to meet high priority requirements within acceptable time limits, considering long leadtimes involved.

For this reason, pipeline funds are no longer be available to close the gap between annual appropriations and expenditures, and future spending levels will depend almost entirely upon the amount appropriated each year.

Military assistance funds are used to provide weapons, material and other assistance in building up the military strength of allied forces throughout the

world, including those around the perimeter of the Communist nations.

Military aid, along with defense support and economic assistance, is a part of an overall Mutual Security Program which is designed to protect the security of the Western nations and, at the same time, serve as a forward military shield for the United States. There are over 40 security pacts between the U.S. and other nations.

During the 10 in life of the program, other nations involved have contributed in excess of \$140 billion to build up their defensive units, compared with the \$22 billion the U.S. has contributed in military assistance to these arms.

## Unacceptable Risks

However, reduction of the pipeline to a level which will no longer permit provision of modern weapons and basic improvements of military aid, the Administration feels are militarily unacceptable.

Congress cut Administration budget requests for military assistance in Fiscal 1959 from \$1.6 billion to \$1.3, and for the first time expenditures dropped below the \$2 billion mark.

An estimated \$1.8 billion will be spent on military aid during the current year, compared with \$2.5 billion for Fiscal 1959.

Although Fiscal 1959 spending was higher than the previous year, congressional cuts in budget requests resulted in \$285 million in modernization work being deferred.

Under the \$2.1 billion was for supplies for the North Atlantic Treaty Organization, including \$74 million for HAWK, \$24 million for Strelawer, \$19 million for Lacrosse and \$4 million for Terrier. Also deferred was \$18 million in aircraft modernization in which \$28 million was earmarked for North American F-100s for Denmark and Turkey and \$10 million in modern anti-aircraft defense patrol aircraft for France.

In addition, ship modernization amounting to \$10 million had to be deferred in Korea and Pakistan, \$14 million requested to build up sea coast armament in France, Greece, Spain, Turkey and Korea had to be deferred, as was \$15 million for modernization of electronic equipment in France and Korea.

The obsolete weapons production program had to be cut by \$16 million, \$4 million being cut of the internal security program for countries in Southeast Asia and the balance of \$67 million is composed of a large number of small sums for many countries.

All this spending was to be deferred to Fiscal 1960. However, the Administration requested \$1.6 billion for that year, \$200 million less than requested in Fiscal 1959, and Congress approved \$1.5 billion, \$200 million less than it approved the previous year.

There are already indications that the reduction in funding for the Fiscal 1960 military assistance program has brought forth of similar reductions on the part of other nations contributing to the support of the military forces involved.

Lack of modern equipment also increases the risk of military aid to meet aggression tends to be impaired and effective fighting strength declines, according to MAP officials.

## Deterrence Impact

Administration of MAP are aware of the danger involved and the impact deterioration of the allied forces would have on the defense situation. Defense experts have said it would be economically impossible for the U.S. to maintain its own force of the size and strength of the combined forces considered the minimum necessary to deter aggression.

Thus, there are strong indications that the Administration will soon ask Congress for a sizable increase in military assistance funds for Fiscal 1961 over the amounts that have been requested for the last three years. This

is in contrast to the Administration's general determination to hold U.S. defense spending at current levels last year, Fiscal 1960.

The Fiscal 1960 budget request for military assistance is expected to be about \$2 billion, the minimum amount recorded by the Defense Committee earlier this year following a thorough study of Military Assistance Program. At the same time, the Administration will also urge that countries which receive aid step up defense efforts in their own behalf because the danger facing these countries are now great.



**Nike Zeus Test Vehicle Firing Fails**

Second test failed to ignite when Nike Zeus anti-ICBM test vehicle was launched at White Sands N. M. (AW Dec. 21, p. 19). The third failed in three attempts. Flying was to have proved data to evaluate structural temperature and control on the Army missile.

face those facing the United States. Continuing Congress, that more action is needed for the Military Assistance Program than has been appreciated during the last few years is not expected to be an easy task during the coming session.

Much criticism has been leveled at the program in the past, which is probably best summarized in a report issued by the House Committee on Foreign Affairs last June. The report said:

"There has been overlooking of the Military Assistance Program to meet urgent requirements such as the provision of military equipment having no relation to the capacity of the United States or of other nations to meet major Soviet aggression... In view of this overlooking, it is apparent that the program should be critically examined."

"Influences in the handling of the program is in many instances lacking. The committee general over the past several years has issued reports after giving detailed programming and funds provision of military assistance. No national instances were reported where action was suggested even though the material was already on hand in sufficient quantities at the recipient country or in a neighboring country in surplus quantities. In some cases spare parts have been disposed of as surplus while replacements for the same items were continuously being procured for delivery from the United States. It is

evident that there has been a complete control of equipment, adequate record-keeping and logs in reporting delivery."

"Much of our military assistance is beyond the capacity of some of the recipient nations to utilize. In some instances, the assistance is received by local governments as representing an effort by the United States to interfere in the domestic policies of the nations involved. In some cases the economy of the country is depressed in favor of large military budget expenditures. A review of the annual military assistance program would result in a evaluation of force objectives in each country and more carefully long-range program costs."

Military assistance officials admit there have been deficiencies in the administration of the program, and while they will never achieve perfection in the assisted supply, logistic and maintenance management patterns of allied governments have been and will continue to be made.

The Defense Committee in its preliminary report to the President, also pointed out there was more for improvement in the administration of the program, he added.

"We are all convinced that the mutual security program, both in its military and economic aspects, is a sound concept. What is needed is the determination to maintain it and the ability

to administer it well. We recommend that every effort be made within the legislative and executive branches of the government to bring clarity to the American people the relationship between the mutual security program and the national interest, and the need for continuance of this program if it is to make its required contribution toward our world position of strength."

Administration officials have thanked for the lack of public understanding which cause most of the program's financial difficulties, but find themselves handicapped in telling the full story for security, political and national interest reasons.

Also, attempts to point out the benefits received from such a program often have little or no impact because in most instances it is a case of dealing with intangibles.

For example, military assistance and defense support, coupled with a system of military alliances with other nations, has built up a total Western strength in which U.S. forces represent about one-fourth of the total armies of 5,800,000 men, about 60% of the 71,000 aircraft available and 80% of the 4,300 combat ships.

There is no concrete evidence that these forces have by themselves been responsible for deterring war, MAP officials observe, and it can only be stated that in spite of the U.S. and other Western nations, it also provides a number of side benefits, including:

• As a result of U.S. contributions to foreign aid more than 250 installations have been made available on foreign soil to Strategic Air Command or other military bases in the forward defense area.

• Military aid serves to suppress the economies of recipient nations, which is a further aid to the U.S. economy, maintain stock piles and undeveloped countries are prime targets of this type of action.

• As the economy of these countries improves, they not only can stand a greater share of the burden of defense, but open up new trade markets in which the entire world benefits.

• About 85% of MAP procurement is in the U.S., which creates more work for industry and boosts employment.

• Big share of the military equipment is purchased through the Air Force, Army and Navy, which permits the services to get rid of surplus equipment at a fair price and aids in its replacement.

## Military Assistance Program Funds

Year	Appropriations Available	Expenditures	Year End Carryover
1950	\$1.3 billion	\$0.1 billion	\$1.2 billion
1951	1.2	0.9	55
1952	1.2	0.5	54
1953	1.9	3.9	8.4
1954	2.9	1.6	77
1955	2.7	2.2	62
1956	1.0	2.6	48
1957	2.0	2.4	42
1958	1.3	2.3	10
1959	1.5	2.5	10
1960	1.3	1.4	26



Hillix X-15 makes a conventional takeoff at Edwards AFB, Calif., with wing fixed in normal position. Vehicle weighs 184 tons.

## Air Force's Tilt-Wing X-18 Makes Conventional Takeoff

Hillix X-18 tilt wing airplane built for the Air Force is being flight tested at Edwards AFB, Calif., at a conventional airfield with wing-engine combination locked in horizontal position. Tests will be continued until enough flight test data is gathered to permit vertical flight test.

In the vertical flight test phase, which will begin in early 1959 the X-18 will be flown to 15,000 ft. altitude after taking off in a fixed wing aircraft. Its wing will be rotated for vertical flight after reaching altitude. In later tests the X-18 will take off vertically and will perform short takeoffs and landings.



Tilt wing X-15 climbs out (left) during test flight with wing locked in horizontal attitude. At right the vehicle goes altitude. Air Force shows phase in part above the horizon. Discovery page at top provides full data for pitch control during hover and transition.

## NATO Meeting in March Will Seek To Resolve 'Integration' Issue

By Robert E. Farrell

Paris—Just talks between Presidents Eisenhower and de Gaulle at the West end summit meeting failed to produce an compromise over French attitude in integration at the NATO Air Defense Command (AW Dec 21, p 24).

NATO sources indicated, however, that talks on the subject at top levels would be carried out between American and French officials between now and a meeting of NATO defense ministers slated for somewhere in March.

It was understood these talks would be carried out within the permanent NATO Council in Paris as well as within the NATO military standing group in Washington. An attempt will be made by French and the U.S. military officials to arrive at a more careful definition of times as to what each country means by integration.

French sources insist in preliminary talks reports that a compromise had been reached between American and French officials on the integration question. Actually, both sides agreed to postpone a showdown on the subject until the March meeting of defense ministers.

NATO military sources were some what disappointed over Eisenhower's failure to budge de Gaulle on the integration principle. This is because it is a tilt to U.S. and other NATO officials that French objectives to subordinate in the NATO Air Defense Command into on political rather than military grounds. De Gaulle isn't expected to give in ground until the U.S. backs its bid for more French air within the alliance.

De Gaulle's political attitude toward NATO also casts confusion on the push outside of last week's Washington report that France, Italy and West Germany had suggested United States withdrawal and for development of an intermediate range ballistic missile project. Such a program—like the current NATO union development of Hawk and Sidewinder missiles—is based on a U.S. policy laid down at the NATO meeting in December, 1957. At that meeting, the then U.S. Defense Secretary Charles Wilson announced that the U.S. was ready to provide technical assistance to NATO nations for development of modern missile systems.

The French Italian German IRBM bid, however, raises the question of control of the nuclear warhead. While the West German and Italian would accept joint control with the U.S. of an IRBM warhead, which procedure would be supplied by the U.S.—it is

highly unlikely that the French would so. Dr. Gaillard already had refused joint control of U.S.-made IRBM warheads. The French instead would prefer U.S. help in developing an IRBM to build which would carry a French made nuclear warhead and would be controlled solely by France. This proposal, however, was rejected by Washington (AW Dec 7, p 29).

Talks between Eisenhower and de Gaulle on the integration issue were conducted in the shadow of the French position, made two weeks earlier in Paris by Gen. Nathan Twining, chairman of the Joint Chiefs of Staff. Twining, in reviewing the NATO military position, complained that national egoism of several NATO nations was preventing NATO military goals from being achieved.

In particular, Twining let hard on French footdragging. He cited French action in refusing joint control of IRBM bases in France. Gaillard's refusal to permit NATO atomic stockpiling in France, which forced transfer of French-held U.S. fighter-bombers to West Germany and England, and French refusal to accept aid with integration of the NATO Air Defense Command. Twining's remarks, which were leaked to the press, later were backed up at a NATO ministerial meeting by U.S. Defense Secretary Thomas Gates, despite a French protest that Twining's statement be repudiated.

Rather than push the issue toward a showdown, both U.S. and French officials decided to postpone the question until the March meeting.

## Renegotiation Board Reports to Congress

Washington—Five defense manufacturers accounted for \$244.5 million—24.9%—of the Renegotiation Board's determination of excess profits during Fiscal 1959, the board reported to Congress last week.

The board made 22 individual determinations reaching \$26.4 million in excessive profits during the year. The 17 determinations against firms outside the defense industry reached \$19.9 million, 7.1% of the total.

Three of the five defense manufacturers accounted for the U.S. Tax Court the Martin Co., Lockheed Aircraft Corp. and North American Aviation.

The board reported that a total of 68 renegotiations cases involving \$99.7 million in excessive profits during the Tax Court on June 10, the end of

## Lockheed-Macchi Deal

General-Lockheed Aircraft later had acquired a large stock interest in Aerometics Macchi, Varese, Italy. Under terms of the agreement, Macchi is licensed to build a new Lockheed Model 96 fighter light utility aircraft designed and flown by George DeSantis (AW Nov 25, p 33).

Both companies and the first airplane would come off the Macchi line in mid-1960. Macchi now holds production rights from the Italian air force for the MB-339 jet trainer and also assembly and manufacturing spare parts for Lockheed T-33 trainers. Licensed cooperation has existed between the two companies since 1945.

Fiscal 1959. Seventeen of the appeals were made by defense manufacturers and involved \$90.9 million. The other 51 cases accounted for \$5.5 million of the contested excess profits determination. From the board reported these results from its Fiscal 1959 operations:

- Of the 1,400 cases completed during the year, 1,219 were closed on the basis of an informal settlement. The closed cases involved negotiable sales of \$15.5 billion and negotiable profits of \$1 billion.

- The 141 determinations issued by the board involved excess profits of \$60.7 million. The 139 cases settled by bilateral agreements between the board and contractors involved \$14.4 million.

- The \$60.7 million in excess profit determinations made during Fiscal 1959 were paid out of the amounts for the preceding years. The board in period the following totals in excess profits determinations for past fiscal years: 1954, \$11 million; 1955, \$15.1 million; 1956, \$15.5 million; 1957, \$16 million; 1958, \$11.5 million; 1959, \$11.5 million. These determinations—minus the acceptance of the board in October, 1951, through Fiscal 1951, aggregate \$154 million.

The board also indicated that through Fiscal 1959, contractors made voluntary refunds and price reductions totaling over \$1 billion, according to renegotiation data submitted by the contractors. It was pointed out that these voluntary refunds and price reductions are to be distributed from price reductions made under the terms of pre-negotiated cost contracts.

- The board estimated the net recovery by the government—after the making of allowance to contractors—during the eight years of the current Renegotiation Law at \$681 million. This includes recoveries through voluntary refunds as well as board determinations. The board reported that net to the government over the eight years has totaled \$29.5 million.



### Cessna 310D Features Swept Tail

Cessna tried to refine swept tail in the Cessna 310D from birth in the company's 1966 line of biplane aircraft (AW Nov. 9, p. 123). Other features include addition of air conditioning, oil cooler and interior style improvements. Price comes at \$99,950. Plane is offered as one of 13 four-cylinder twin configurations, high stability, paint stripping a optional. Seats include individual armrests as standard equipment to facilitate comfort and ease. *Transcendence* two seat Continental 80-670 D fuel injection engine rated at 250 hp each. Gross weight is 4,550 lb.

## Japanese Deny Electronic Imports Pose Threat to U.S. Security

Washington—Japanese electronic exports have denied that imports of Japanese semiconductors are as will be a threat to the national security of the U.S. in a brief that last week, with the Office of Civil and Defense Mobilization.

The action was in reply to an 18-page memo from the State Department, which requested that the Office of Civil and Defense Mobilization investigate weaknesses in parts of Japanese technology to determine whether they threaten American security. (AW Oct. 5, p. 117). The memo pointed out that despite a 17% drop, Japanese imports in two short years had grown from a handful to about 25% of the total U.S. production in terms of value.

In their petition, the Japanese point out that they are competing with in the field of low cost transistors used for consumer products, such as portable

radios and not in the quality military semiconductor market where the unit price is considerably higher. As a result, Japanese imports were only 2.7% of the U.S. semiconductor industry's dollar output in 1975 and are estimated at \$ 2.55 in 1979.

REA President David R. Hill, in public statements, has warned that failure to control Japanese semiconductor imports would make it necessary for the U.S. to "help Japan launch production of equipment indispensable to its security," and would consent to allow to eventual establishment of rival defense industries 4-500 in across the Pacific Ocean.

The Japanese position points out that Japan does not produce quality transistors for military use, because there is no Japanese government sponsorship of, or need for, such develop-

ments. The two American politicians continued in U.S. defense contracts and the need for close liaison between the military semiconductor device design and the military equipment design are cited as reasons why Japan poses no threat to domestic production of military quality transistors.

Electronic Industries Assn., and some domestic manufacturers that have fled heads in support of its position, say that domestic semiconductor research and development effort is largely supported by the profit from the sale of semiconductor type transistors. Loss of sales profits, due to imports, would hit hard at development of new semiconductor devices needed for defense.

The Japanese sharply deny that profits from semiconductor transistors will finance the bulk of U.S. semiconductor R&D. Rather, they say, it is government funding either directly or indirectly, that supports most of the semiconductor research, development and innovation. The position cites Defense Department contracts, testing

units, millions of dollars, which provide for semiconductor research and development and for establishing semiconductor manufacturing facilities (AW Nov. 30, p. 74).

The Japanese agree with EIA that semiconductor research and development is vital to national security. But they say it is too vital to depend upon the sale of portable transistor radios for financial support. The Japanese suggest that the Defense Department

## Miami Survey Indicates Support For Competitive Space Program

Miami—Of more than 1,000 persons who answered a Miami Herald space quiz, 68% said the U.S. should "adopt a new tighter-in-hold policy and throw all of our national energy into catching up even if it means we must reduce our living standard."

Just over 70% said they would be willing to pay twice income taxes in amounts ranging from \$10 to more than \$750 next year if it would all be spent for space research.

"Believing by the majority, however, that the Soviet Union's lead in space accomplishments by 35.1% of those who answered. Democratic reaction was divided by 24.5%. Republican reaction by 22% and said that the American people to show concern by communicating with government leaders was blamed by 35.3%.

The quiz consisted of 10 questions and each question offered a choice of answers. Although none of the questions asked for a yes/no answer, a number of those who answered the quiz to the newspaper attached their own comments including criticism of President Reagan, the Times and other news sources, and the suggestion that the civilian space agency be elevated to cabinet rank and run by a man "who knows how to knock heads together, especially military heads."

The newspaper said the response to the quiz indicated that the subject did not have broad, general appeal and that the current cost of space from people who could be called "stratons."

Given a choice of saying they were "alarmed" because we were "behind" (in the space race) and "disappointed" in the leadership which "permitted it" or saying "I am not too concerned because we can catch up if we have to," 78.2% chose the former answer, and 13.3% chose the latter.

Fifty-one and four-fifths per cent was the greatest danger resulting from the Russians lead as a political cost, 35.1% and it was raised and 8.6% thought it was a moral danger.

would have been serious in its duty if it had not provided government support for space research. But the survey failed upon industry points from the side of the containment-type device.

The Japanese position also cites a number of space defense weaknesses for possible inclusion in the future. But they say it is too vital to depend upon the sale of portable transistor radios for financial support. The Japanese suggest that the Defense Department

would have been serious in its duty if it had not provided government support for space research. But the survey failed upon industry points from the side of the containment-type device.

## News Digest

Boeing Airplane Co. is scheduled to award a contract to American Airlines & Frontier and American Co. & Frontier jointly for development of a mobile launcher railroad car for Boeing's new supersonic transport. Combining a previous letter contract, Air Force has awarded a \$11.5 million research and development contract to North American Aviation, Inc. for development and test of tactical guidance and flight control systems, including ground support equipment, for the American Airlines. The contract was awarded to North American Aviation, Inc. for development and test of tactical guidance and flight control systems, including ground support equipment, for the American Airlines. The contract was awarded to North American Aviation, Inc. for development and test of tactical guidance and flight control systems, including ground support equipment, for the American Airlines.

Western Air Lines agreed to order for three additional Lockheed turboprop Electra aircraft, bringing its fleet to 12 (AW Oct. 12, p. 41). Two of the aircraft purchased under the \$7.5 million contract will be delivered next July, the third in August.

General Aircraft Engineering Corp. is making a three-month feasibility study to determine applicability of a nuclear propulsion unit to nuclear-powered aircraft. The study will include a feasibility study, reactor analysis, reactor shielding, radiation effects on materials and reactor controls. It is a complex, funded project.

Dauphin Missile 40A, prototype for the Mirage 4A concept jet bomber, has flown at a speed slightly above Mach 1.5 for 20 consecutive minutes. French aircraft builder has had authorization for an order of 90 Mirage 4A's, but has not yet received a contract. The aircraft is expected to be in service by 1980. (AW Oct. 7, p. 29).

North American Aviation is expected to award a contract to North American Aviation for the development and test of tactical guidance and flight control systems, including ground support equipment, for the American Airlines.

Boeing B-281 helicopter began an 11,000 mi. demonstration tour of Central and South America which is expected to reach all major cities and military installations.



premier, the world's second in doubling the number of frequencies available, so that the current remaining band of 32 mc will be sufficient, Arne said.

An Linc Dependence Area, however, has challenged the stand. The organization contends that none of the services has indicated just when it is ready to implement the 56 to 60 spacing when they will replace the frequencies allocated to FAA or when it will determine whether the remaining facilities are adequate for service to the pilot or operational control.

Major problems in dispatching is that air traffic control personnel "misinterpret" the pilot's communications based on the ATIS frequency to a point where pilots and dispatchers often cannot exchange weather and other information or discuss operational decisions, associations said.

## Vertol 44 Operates Experimentally Over North Italy Passenger Route

Milan, Italy-Bologna, a passenger helicopter service in northern Italy, has completed its scheduled series of experimental operations between this city and Bologna, Saletovich said.

Because of the operations was to study the possibility of helicopter service in the Val Padana area north of Milan. Route flown connected both cities with the Milan airport at Malpensa, a small, scenic area, and was to be flown on a regular basis.

Service was flown with a Vertol 44B

As an example, said the union, two trucklines Boeing 707s were forced to stop Offshore Tolls in Chicago, in November, and passed to Detroit because dispatchers were unable to construct them in advance of operational decisions to do otherwise.

Claiming that FAA is unable to offer any data for "getting off" the limited frequencies, the union complained that "when most common calls are made, we will find the FAA, with a quota of non-frequencies in hand, leaving us at either operation and Arne communications the most is one." ALPA added that the agency's request for frequencies "is not up to be the last" and would likely bring about limited job opportunities for pilot operators because airlines will first consolidate their remaining frequencies for common usage.

This northern sector of Italy, is a natural for helicopter service. It includes several large cities of more than a half-million population, in addition to Milan which is now adding to the two million mark. Most of Italy's heavy industry is concentrated here, and so is much of the basic agricultural economy. The only major airport in Malpensa which serves Milan and the area around it, but Malpensa is remote, too far out of the city.

Work is progressing on modernization of Linate Airport, much closer to Milan, but use will limit Linate to local service.

Traffic between these cities is mostly by road now. One example shows why: from Bergamo to Milan is about 50 miles by air, from Bergamo to its airport is about 90 miles.

### Weather Factor

Another problem to the use in the weather. Experienced travelers to or in northern Italy seldom schedule an airplane trip in November to February, because of the great percentage of time that the airports are closed due to weather. Elpidonio said that these few months must be regarded as solid IFR conditions in any planning operation.

The traffic potential, the long distances from city to airport and the weather conditions to land into helicopter operations, the specifications for his aircraft, big, economic, reliable, safe and capable of IFR flight.

Elpidonio said that this helicopter is not suitable yet and may not be for a couple of years.

Elpidonio opened out of the Milan airport, located just a few hundred feet from the central railroad station. The airport is conventional with a useful runway area landscaped for landings and takeoffs. Total area of the airport is about 100 sq ft with an open grassed area 250 ft by 3,000 ft including the area for emergency intervention landings.

The approach to the airport is very flat in both directions.

Milan's future airport will be a 250-1,000 ft area and will also be a well-run station now under construction. However, the new area is not expected to be ready before 1965.

### Financial Background

Elpidonio is financed by private and public capital. The city of Milan has a half interest in the corporation, and the other half is split evenly between Milan industries and banking interests.

President of Elpidonio is Agostino Cassinelli, and vice president is el Milan. Milan lawyer Paolo Mattina is administrative director, and Comandante Enzo dell'Acqua is chief of operations.



**Air-India's First 707-420 Rolls Out**

Air India International's first Boeing 707-420 International is rolled out at Heathrow, Wash. The transport will enter service in early 1966, flying to Bombay, London, Cebu and Tokyo. The 151st aircraft, one of three ordered by Air India, is powered by four Rolls Royce Conway turbojets. This 707 is the 94th to be rolled out by Boeing's Transport Division.

## Allegheny, Mohawk Awarded New Routes

Washington-Allegheny Airlines and Mohawk Airlines routes were extended to Boston by the Civil Aeronautics Board in an expansion of local airline service, stemming from the Northeastern States Area Investigation.

The Board also awarded a number of cities from the route structure of five major trunk airlines as an overall plan to improve air service in the New England states. Allegheny will serve Boston on a five-day schedule, and Mohawk was extended to Cleveland and Boston for a three-day trial period.

Need for commuter-type, short-haul air services to cities between Washington and Boston was stressed by the CAB in extending Allegheny Airlines' route between New York to Boston creating a new local service. With single-stop service via the intermediate cities of Baltimore, Md., Wilmington, Del., Philadelphia, Pa., Trenton, N. J., New York City, Islip, N. Y., Bridgeport, New Haven, Hartford and New London, Conn. and Providence, R. I.

While this heavily populated area is presently served by one major trunk carrier, CAB said that the total of such service follows no definite, planned pattern. Total length of the Washington-Boston route is 399 mi., covering 15 cities with a combined population, including New York, Newark and

Islip, of nearly 14 million, the Board noted, requiring a commuter-type service that can not presently be offered by the trunk airlines.

"On the whole, we conclude that if there is to be a sound, integrated and complete local service program for the cities on an Atlantic Coast route, a local service carrier must be authorized to put the program into effect," CAB said.

### TCA Jet Surcharge

New York-TWA-Canada Air Lines faces dropping the surcharge for transatlantic jet operations and plans to offer stand-alone fares on its Rolls-Royce Conquester Douglas DC-8s when they go on the route next June. International Air Transport Association is scheduled in its Board of directors meeting in October (AW Oct. 13, p. 35) and no rate structure has been established for the North Atlantic after April 1, 1966.

TCA, however, believes a special IATA surcharge will be held and the jet surcharge will be eliminated in the new rate structure. If IATA does not drop the surcharge, TCA will be forced to apply it. But the carrier will fight its position in any special meeting.

TCA also expects to be the last North American carrier without a jet surcharge. Transcontinental service with scheduled service and fast lane fares, is scheduled to begin April 1 with the DC-8.

CAB also authorized a new Hamsburg, Pa.-Washington route separate for Allegheny, added Reading, Pa. to the airline's route system and eliminated restrictions on the carrier's stop-over authority.

Mohawk Airlines was placed in the New York-Boston market by an extension of the airline's routes from Poughkeepsie, White Plains, and New York, N. Y., to Providence, R. I., and Boston. Mohawk also got a route separate between Utica and Syracuse, N. Y. and Cleveland, Ohio, via the intermediate cities of Albany, Binghamton, Binghamton, Elmira, Oneonta, and Jamestown, N. Y., and Massillon, Pa.

Reviewing transatlantic activity in the New England area the Board decided to terminate Northeast Airlines' authority to serve Baltimore, Canton and State Bridgeford, Me., Northampton and Portsmouth, Mass., Chelmsford and North Carolina, N. H., Bridgeport, N. H., Haverhill, Stamford, New Canaan, Conn., and St. Johnsbury, Vt. CAB also voted to suspend Northair's service at New London, Conn. during the period Allegheny is authorized to serve the point.

American Airlines authority to serve Binghamton, Elmira and Utica was terminated, and American's service to Bridgeport and New Haven, Conn. and Washington, Del., was suspended while Allegheny serves the three cities.

Capital Airlines service at Reading and Allegheny's service at Bedford, Pa., were also terminated by the Board.

## British Hlt PanAm Jamaica Jet Service

New York-Pan American World Airways had north west to expand through-plane jet service from New York to London, Jamaica, and Cuba. The airline is a result of British objections to the new service on grounds that it breached the U. S.-Great Britain bilateral covering the Caribbean routes available. Pan American previously had served Ciudad Trujillo from New York, and Jamaica from Ciudad Trujillo and also had operated a route from Miami to Jamaica via Ciudad Trujillo. It was the new through-plane service from New York, interrupted by the north west, the first west with Boeing 707-120 jet equipment that caused the British objection.

The U. S. State Department told Airlines Week that the British were justified in preventing Pan American from operating a through flight from New York to Jamaica via Ciudad Trujillo because there is no provision for such service in the bilateral. Pan American had set up the service with a 10-day, January in Ciudad Trujillo and a change of flight number, but with the single-plane service. State Department and the U. S. probably would make the case through under the same current terms. However, the case, according to State, will be brought up in U. S.-British consultations on the Caribbean area scheduled in February next. At that time, the U. S. hopes to resolve the problem in the New York-Ciudad Trujillo and Ciudad Trujillo-Jamaica routes can be agreed to permit through jet service. Pan American's flight 707 of last Tuesday, scheduled from New York to Jamaica via Ciudad Trujillo, was the first aircraft and passengers were advised in a printed memo that they would be accompanied by a change from jet to Douglas DC-8B equipment for the second leg of the flight. Pan American said its passengers it believed the problem arose from "intergovernmental misunderstanding."

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Eastern Air Lines' \$20 million passenger terminal at New York Idlewild Airport has two 330-ft. passageways which provide 16 gates. Twenty-four aircraft can be parked simultaneously on the apron. Terminal is used by 104 daily scheduled and outboard flights.

### Eastern Opens Passenger Terminal at Idlewild



At super-levelled runway and taxiway and all loading and unloading. Eastern aircraft are visible from 55 ft. high, conductor's tower (above, left). Conductor controls all movement of aircraft and ground vehicles on terminal's open area, and controls passenger information. Upper and lower vehicle elevators are enclosed behind 375-ft. facade (above, right). When lobby is on second floor (below, left), rising pedestrian ramps (below, right) connecting first and second levels are hung from stainless steel cables.





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## Airline Income & Expenses—October, 1959

(In Millions)

	Passenger Revenue	U. S. Mail	Expenses	Freight	Charter	Total Operating Revenue	Total Operating Expenses	Net Income Before Taxes
<b>DOMESTIC TRUNK</b>								
American	31,499,376	664,317	385,648	3,352,220	71,043	39,387,964	32,466,342	5,921,622
Boeing	5,666,337	122,222	33,544	198,477	1,000	5,988,176	5,116,416	871,760
Capital	8,484,342	21,527	107,643	140,263	29,223	9,282,994	8,844,324	438,670
Continental	4,446,800	61,800	48,000	88,000	24,000	4,726,600	4,420,000	306,600
Delta	7,666,800	172,000	111,400	167,000	8,700	8,026,300	6,956,000	1,070,300
Eastern	30,912,422	411,937	546,324	1,468,000	49,416	32,887,695	22,816,300	10,071,395
National	5,794,767	11,348	37,702	168,200	16,743	6,028,860	5,392,800	636,060
Northwest	1,531,394	4,800	10,000	30,000	1,000	1,577,194	1,468,000	109,194
Republic	4,865,342	118,891	420,847	20,000	20,263	5,244,543	4,748,100	496,443
Town World	10,846,320	203,895	1,411,347	1,411,347	146,171	13,582,633	10,296,600	3,286,033
United	12,126,448	761,412	2,172,163	1,172,163	20,263	15,854,327	13,327,000	2,527,327
Western	5,158,823	118,822	33,016	101,448	20,263	5,471,666	4,466,714	1,004,952
<b>INTERNATIONAL</b>								
American	441,348	9,766	204	48,823	28,149	528,146	594,143	-75,997
Boeing	158,183	14,833	4,424	4,424	28,149	205,569	205,569	0
Continental Atlantic	131,443	5,291	19,229	1,000	1,000	147,763	147,763	0
Delta	308,000	2,860	1,000	1,000	1,000	312,860	312,860	0
Eastern	1,471,133	37,724	86,826	1,000	22,644	1,618,227	1,578,227	40,000
National	118,783	1,000	1,000	1,000	1,000	121,783	121,783	0
Northwest	158,183	4,837	3,017	17,230	1,000	184,260	184,260	0
Republic	1,471,133	37,724	86,826	1,000	22,644	1,618,227	1,578,227	40,000
Town World	32,193,000	1,000,000	497,400	2,400,000	1,000	35,593,400	26,778,500	8,814,900
United	1,471,133	37,724	86,826	1,000	22,644	1,618,227	1,578,227	40,000
Western	1,471,133	37,724	86,826	1,000	22,644	1,618,227	1,578,227	40,000
<b>LOCAL SERVICE</b>								
Allegany	291,166	10,448	12,112	34,870	12,112	348,666	348,666	0
Boeing	1,471,133	37,724	86,826	1,000	22,644	1,618,227	1,578,227	40,000
Capital	184,794	6,000	3,000	7,200	1,000	191,994	191,994	0
Continental	852,889	14,443	4,424	30,000	17,230	918,566	918,566	0
Delta	1,471,133	37,724	86,826	1,000	22,644	1,618,227	1,578,227	40,000
Eastern	776,442	9,766	204	48,823	28,149	843,364	843,364	0
National	1,471,133	37,724	86,826	1,000	22,644	1,618,227	1,578,227	40,000
Northwest	1,471,133	37,724	86,826	1,000	22,644	1,618,227	1,578,227	40,000
Republic	1,471,133	37,724	86,826	1,000	22,644	1,618,227	1,578,227	40,000
Town World	1,471,133	37,724	86,826	1,000	22,644	1,618,227	1,578,227	40,000
United	1,471,133	37,724	86,826	1,000	22,644	1,618,227	1,578,227	40,000
Western	1,471,133	37,724	86,826	1,000	22,644	1,618,227	1,578,227	40,000
<b>NARRAGAN LINE</b>								
Alaska	214,843	3,023	8,793	8,793	112	226,571	226,571	0
Boeing	456,356	1,076	1,076	1,076	84,592	543,099	470,326	72,773
<b>CARGO LINE</b>								
Allegany	291,166	10,448	12,112	34,870	12,112	348,666	348,666	0
Boeing	1,471,133	37,724	86,826	1,000	22,644	1,618,227	1,578,227	40,000
Capital	184,794	6,000	3,000	7,200	1,000	191,994	191,994	0
Continental	852,889	14,443	4,424	30,000	17,230	918,566	918,566	0
Delta	1,471,133	37,724	86,826	1,000	22,644	1,618,227	1,578,227	40,000
Eastern	776,442	9,766	204	48,823	28,149	843,364	843,364	0
National	1,471,133	37,724	86,826	1,000	22,644	1,618,227	1,578,227	40,000
Northwest	1,471,133	37,724	86,826	1,000	22,644	1,618,227	1,578,227	40,000
Republic	1,471,133	37,724	86,826	1,000	22,644	1,618,227	1,578,227	40,000
Town World	1,471,133	37,724	86,826	1,000	22,644	1,618,227	1,578,227	40,000
United	1,471,133	37,724	86,826	1,000	22,644	1,618,227	1,578,227	40,000
Western	1,471,133	37,724	86,826	1,000	22,644	1,618,227	1,578,227	40,000
<b>RECAPITULATION</b>								
Chicago-Washington	181,689	127,474	11,106	11,106	112	294,469	294,469	0
Los Angeles-Albuquerque	15,857	15,857	1,106	1,106	112	32,932	32,932	0
New York Airways	73,422	3,443	1,106	1,106	112	78,083	78,083	0
<b>ALASKA LINE</b>								
Alaska Airlines	184,794	48,567	1,106	1,106	112	234,569	234,569	0
Alaska Central	71,443	2,763	1,106	1,106	112	76,424	76,424	0
Gateway	127,000	102,479	1,106	1,106	112	230,595	230,595	0
Elko	46,000	4,400	7,200	7,200	112	57,600	57,600	0
Northwest Consolidated	65,612	42,424	1,106	1,106	112	109,254	109,254	0
Pacific Western	442,911	42,278	2,274	2,274	112	487,465	487,465	0
Trans-Alaska	102,889	46,344	1,106	1,106	112	151,449	151,449	0
West Alaska	40,443	22,124	1,106	1,106	112	63,785	63,785	0

\* Not available. \* Property taxes. \* Not operating income. \* Not available for transportation. \* Includes federal subsidy.  
 † Airlines include figures for freight and express business. \* Commence and stop.  
 Compiled by AVIATION WEEK from airline reports to the Civil Aeronautics Board.

## AIRLINE OBSERVER

► Congress can be expected to take a close look at subsidies to local airline carriers next year, particularly if subsidy costs climb as high as forecast. However, since a vast number of companies are on Civil Aeronautics Board records as having requested adoption of routes that are unprofitable, it is very unlikely that any severe cutbacks will take place. Chances are strong that there will be another move to pass a bill designed to prohibit a carrier of subsidy from returning to subsidy.

► Air Traffic Controller Assoc. is calling for the publication of an official glossary of air traffic control terms and phrases in a public field document so their meanings will be a matter of public record. Controllers want an official glossary to standardize operations and to serve as a final authority in the event of disputes in hearings.

► Aeroflot plans to build 15 heliports along the northern Russian coast to provide regular transport and special two helicopter service direct to the doors of large sanatoria and health resorts in the area.

► American Express Co. has broken into the airline credit field with a contract with Alaska Airlines permitting use of American Express credit cards for the purchase of tickets, vacation tours, excess baggage charges and personal freight shipments. Previously, only Hilton Credit Corp. and the Diners' Club had successfully entered the airline credit field (AW Sept. 14, p. 49).

► Alitalia, Italian airline which last year fought vigorously for a high re-charge on jet flights (AW Oct. 27, 1958, p. 26), is now predicting fare reductions by 1961 of 20 to 30% below current prices on grounds that jet operating costs will be 30% below present engine aircraft operating costs.

► Varig Airlines of Brazil has contracted with Lockheed Aircraft Service for maintenance and overhaul of its fleet of Sud Caravelle turboprop transports. The airline began service last week with the new aircraft on its Rio de Janeiro-Nassau-Port of Spain-Buenos Aires de Janeiro-Sao Paulo-Montevideo-Buenos Aires route.

► Trans-Africa Airlines is planning a daily utilization of 12.5 hr. for its Lockheed Electra.

► Pan American World Airways continues talks between Seattle-Portland and Honolulu to apply on turboprop flights as well as piston engine flights has been upheld by the Civil Aeronautics Board. Complaints by Northwest Airlines and the City of San Francisco that the lower fares were discriminatory gave they did not apply to jet service between Honolulu and San Francisco-Los Angeles (AW Nov. 23, p. 38) were dismissed by the Board.

► Official Soviet spokesmen on the Tu-114 turboprop transport place the overall length of the airplane at 177 ft.—about 20 ft. longer than the Douglas C-119 Cargomaster. The Tu-114's height is 49.2 ft., fuselage diameter is 13.8 ft. and wing area is 3,747 sq. ft.

► Airlines were quick to file protests against a current proposed ruling by the Federal Aviation Agency calling for FAA approval and inspection of all electronic gear installed on aircraft for either permanent or test use. However, complaints were withdrawn when the Air Transport Assoc. pointed out to the carrier that such approval and inspection represented a strong legal protection for the airlines in the event the cause of an accident could be traced to electronic equipment.

► General Electric will flight test its CJ805-23 turbo engine in January. The two engines used in obtaining data on CJ805-3 performance (AW Dec. 21, p. 24) will be fitted with altimeter sections and reinstalled in the company's Phantom B-60A. The CJ805-33, rated at 15,800 lb. thrust, will power the Convair 440 jet Interceptor.

## SHORTLINES

► Aero Engine Division of Rolls-Royce Ltd., reports its turbojet and turboprop engines have completed 10 million hrs. in airline service. The British company says their engines have flown 2.5 million engine miles on the 490 Rolls-Royce-powered airlines in service in 56 nations as an indication. The company's engines are installed in Vickers Viscounts, Fokker Friendship and Fairchild F-27 turboprop aircraft and in de Havilland Comet 3 and Sud Aviation Conquest turboprop aircraft.

► Braniff Airways will begin the first commercial air service between the southwestern U. S. and Mexico, Colombia, Jan. 6 when DC-7C airplanes will be inaugurated through the Houston gateway. Braniff plans to begin its Boeing 707-227 turboprop transport service on its Latin American routes in early spring.

► Flying Tiger Line reports air freight revenues of \$11,168,669 for the 11-month period ending Nov. 30. During the same period at 1958, the all-weather airline reported revenues of \$10,761,269. Flying Tiger also announced that its November monthly figures were 10.4% above those for the same month of 1958.

► National Airlines has received a five year renewal authorization from the Civil Aeronautics Board to serve Melbourn, Fla., on its Miami-Houston route and permanent authorization to serve Panama City, Fla., on the route.

► Pan American World Airways has started two weekly round trip flights from New York to Bermuda using Boeing 707 International turboprop transports. In addition to the two turboprop flights, Pan American is operating three weekly flights from Boston using Douglas DC-4B and DC-7C aircraft.

► Southern Airways has received authority to serve 19 additional cities in Tennessee, Alabama and Mississippi from the Civil Aeronautics Board, bringing the airline's service to a total of 54 cities covering 3,655 route miles. The new order will become effective on Feb. 26.

► Trans World Airlines has added Paris and Rome to its Boeing 707 international service and carried its 500,000th turboprop passenger on the inaugural flight to the two European cities. The 707 made the New York-Paris segment of the trip in 3 hr. 53 min.—57 min. ahead of schedule.



THE J-75—RUGGED AND POWERFUL

Pratt & Whitney Aircraft's J-75, the world's most powerful turbojet engine, is demonstrated for reliability, economy, and outstanding fuel economy. In two of the U. S. Air Force's newest aircraft—the Republic F-105 fighter-bomber and the Convair F-106 interceptor.

The J-75 drives its basic powerplant from the basic Pratt & Whitney Aircraft J-57 and delivers more than 24,500 pounds of thrust with afterburner. Commercial version of the J-75, together with the J-52, power a total of two of all Boeing 707 and Douglas DC-8 jet air liners now in service (or on order).

REPUBLIC F-105    BOEING 707    BOEING 707    BOEING 707

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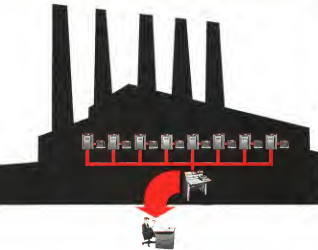
Through constant research and a traditional talent for utilizing the best engineering minds, programs for the future are being developed and produced at Pratt & Whitney Aircraft, utilizing airborne nuclear power and other advanced applications of energy for space vehicles. These projects will open still new frontiers in the world of flight.

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## AERONAUTICAL ENGINEERING



SUPERSONIC all-weather Republic F-105 has flown faster than Mach 2 at 50,000 ft. Prototype speed broke sounds at Mach 2.

## F-105 Spearheads TAC Fighter Forces

By Robert L. Stenfield

Seymour Johnson AFB, N.C.—The first Air Command's supersonic Republic F-105 fighter bomber, declared operational on Jan. 1, 1969, has demonstrated an overall improvement over age-outstanding test flights and pilot dashboards of better than 70%. More than 900 pilots have flown the Thunder chief over 4,000 hr without a single in-flight engine failure or failure.

First engine designed from scratch as a fighter bomber for TAC, the F-105 also is the first engine in Air Force history to fly a full 18 months without a major accident. The almost fail-safe automatic F-105D—with its own radar and bombing capabilities therefore not possible in TAC—is being described as the "Tactical Air Command answer to the Strategic Air Command mission."

### Fighter Unit

For an m-to-m check of F-105 operational capabilities, the Aviation Week editor flew to the home base of TAC's 4th Tactical Fighter Wing. The 4th is currently the only Air Force unit that has the big, single place Thunderchief which, with its nuclear payload, will be the No. 1 fighter unit for TAC's Composite Air Strike Force. The F-105s, approaching the first year of operation,

2,000 test air wings without air-to-air refueling and with an operational ceiling in excess of 50,000 ft. can fly faster than Mach 2 at 35,000 ft. It also has attained speeds at Mach 1.34 and 1.39 at sea level and at 4,500 ft. On Dec. 12, piloted by Brig. Gen. Joseph H. Moore, commander, 4th TFW, the F-105 flew 1,216.4 mph for a new world's speed record for the 100 km (62.14 mi) closed course at Edwards AFB, Calif. (AW Dec. 21, p. 20).

•Rate of climb. The Thunderchief, with water injection, has climbed to 52,000 ft in 55 sec from standstill on

the runway. From "grass up," at an initial speed of 175 kt, the F-105D has reached 40,000 ft in 2 min and 1 sec.

•Weight. The F-105 is 63 ft 1 in long, with a wing span of 34 ft 11 in and a height of 19 ft 8 in. Empty weight (gross fuel) is about 28,000 lb. Operational weight (clean) approximates 34,000 lb. Fully loaded—with three 950-gal external tanks, plus bombs, low tanks (it can't burn both fuel and its weapons in the bomb bay)—it will gross about 46,000 lb. This figure is expected to increase to over 52,000 lb. In later models the fuselage may be lengthened and the wing area increased.

•Engine. Powerplant is the Pratt & Whitney J75 of 15,300 lb thrust, plus afterburner. The J75 engine, which powers the F-105D (with 75 B models will be built), delivers total thrust up to 33,500 lb. The J75W series, which powers the new F-105D, generates a total thrust of 28,500 lb (wet) and 35,000 lb with water injection. The J75, with afterburning, is expected eventually to reach the 35,000-lb thrust range.

### Private Venture

The F-105 actually was a private venture of Republic Aviation Corp., Farmingdale, N.Y. First experimental XF-105A was flown in Oct., 1955. First F-105B was flown in May, 1956. The all-weather "F" made its first flight



REG. 905. J. H. MOORE



THUNDERCHIEFS of the Fourth Tactical Fighter Wing on the tarmac at Seymour Johnson AFB, N.C. In command: average bottom 70%.



ASSEMBLY line at Republic's Farmingdale, N. Y., plant. Fighter-bomber is 63 ft. 3 in. long; Span is 34 ft. 11 in.; height is 19 ft. 6 in.



F-105 has climbed to 82,000 ft. in 55 sec. from a standard. Following gear retraction, the Thunderchief has climbed to 40,000 ft. in 2 sec. 1 sec. The Pratt & Whitney J75 powerplant is expected eventually to reach the 30,000 lb. thrust stage.

June 9, 1959. Some 61 F-105s have been produced to date, including about 16 test airplanes of which two are the F-105D. The test of the B-1 are currently saving of the Republic production line.

Anytime you first delivered in May, 1958, to the 4th Tactical Fighter Wing's 315th Squadron, the first wing organization to test such an aircraft at Eglin AFB, Fla. About 15 aircraft have been delivered to the 315th at Eglin, in addition to 18 going to the 714th and now to the 705th Squadrons at Seymour Johnson. The 315th Squadron at that base, now being North American F-105 Super Sabres, will be the first unit to receive the F-105D. At full strength the wing will have about 72 aircraft.

The F-105D also will replace the F-100 in service in U.S. Air Force Europe (USAFE) and Pacific Air Forces (PACAF), and is expected for delivery to the 450th Combat Crew Training Wing at Nellis AFB, Nev., early next year. About 100 F-105Ds are expected to be deployed to Europe within the next 12 months. To date TAC has negotiated firm contracts for 120 airplanes and has progressed for something over 340 aircraft.

Strong possibility exists that TAC will program an additional 400 Thunderchiefs which, with its initial planning estimates, could eventually give it over 900 F-105s. Total spending of Tactical Air Command, into a Much 2 fighter bomber fleet, should be completed by 1964.

On the European side, Republic, fol-

lowing an assessment by a 10-expert team, is offering the F-105D at a \$5.4 million (a fixed-price contract) in Holland and Belgium where the airplane would be built. These countries combined have committed about \$220 million of their own money for production of from 250 to 300 aircraft. This would be about half the cost for this number of F-105s, the remainder of the money would be funded via rental aid. Also competing for the Dutch-Belgian Air Force order are the Northrop N-155B, the Lockheed F-104 and the French Dassault Mirage 3A (AW Dec. 21, p. 20).

#### Pilot Transition

TAC requires its commanders to be proficient in primary aircraft and Gen Moore is one of but only three general officers who have flown the single-engine F-105. All transitioning is by the pilot alone, who is checked out by an instructor pilot in another F-105.

Two F-105D transitioners being built by Ryan Division of American Can & Foundry, are still about a year from completion.

The F-105 "is the finest airplane I've ever flown and checked out in... it is a high-performance airplane," Gen Moore told Aviation Week. Rep capabilities of the weapon system which, with air refueling, can strike an air target in the world and which, at 40,000 ft., has been defined as "equal to the Boeing B-52 Stratofortress in accuracy," include:

• **Maneuver.** TAC pilots feel they can

now perform maneuvers previously flown by large bombers with large crews. F-105D is capable of backslapping top level flight bombing, low-level blind LARS maneuver, automatic and blind direct hit bombing. The D model is aimed at very hard under any weather conditions, including break fire and all-out war concepts. The long bomb has been also adaptable for an air-launched ballistic missile.

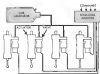
• **Armament.** The F-105 is the first fighter with a bomb bay for internal carrying of a nuclear weapon, negating some problems. Airplane carries nuclear and thermonuclear bombs as well as conventional types, in addition to Sidewinder, Bullpup and Whizz-Liner missiles. Armament also includes a semi-enclosed General Electric M-61 20 mm Vulcan automatic cannon (is internal station "Carling gun") that fires 6,000 rounds a minute. Cannon is equipped with a hollow fuel system, saving 60 lb. of space which is utilized to house radar equipment.

• **Navigation.** The AN/APN-133 display airborne navigation system (built by Laboratory for Electronics, Inc., Boston, Mass.), installed in the F-105D, automatically and independently of ground navigation—through a self-contained computer—supplies the pilot constant present-position coordinates, ground speed, track, heading and distance to target, wind direction and velocity, and alternate destination selection. No dual redundancy is required of the pilot.

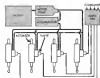
NASSAR (North American Search and Range Radar) navigation and fire

# TEST-PROVEN GAS SERVO

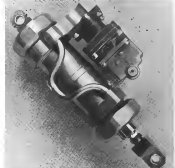
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Compact valve-actuator assembly has been tested repeatedly in closed loop positive position system with lightweight test propellant engine system.

## SIMPLE, RELIABLE DESIGN

General Electric has developed a proportional gas servo system for actuation control in high and low temperature and radiation environments where hydraulic actuators are undesirable. Usually a three servo with position feedback and electrical indication, it has only three major components—no engine source, a valve-actuator, and a stabilizing amplifier.

By using gas energy directly, rather than converting it to hydraulic power first, the system also tolerates steady-state pressures of 1,000 PSI and higher for short missions. In addition, the number of parts is kept to a minimum, simplifying the design and increasing its reliability.

## USE HOT OR COLD GASES

The gas servo system operates effectively with hot gases from solid propellants or liquid fuels as well as with compressed stored gases. Hundreds of hours of compressed air testing and many hot shots have been completed successfully.

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1911

## IMPORTANT BENEFITS

This proportional servo offers significant advantages:

1. High frequency response through pressure control rather than flow control. Demonstrated 10 cps at 90 deg phase lag, with 130-lb load. Higher response is possible with increased control bleed flow.
2. Minimum gas consumption through use of two-stage closed-center valve.
3. The system is flexible. Dumping, off-line, and recovery characteristics are controlled electrically without change of hardware.
4. Proportional motion minimum leakage. Having no close-fitting sliding parts, they are well suited for high-temperature operation and lesser thermal shock problems.
5. Symmetry of design minimizes effects of G-forces, and avoids roll shifting.

## NO DROUGHT PROBLEM

Because it is a dry system, the G-E gas servo elements virtually all the problems resulting from the water storage of liquids—thermal expansion, leakage, evaporation. This reduces maintenance and helps ensure continuous operation.

For further detailed application information, contact your nearest G-E Aircraft Auxiliary Turbine Dept. representative.

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**GAUCH CITY, IN**—W. J. W. Binkley, 180 Old Country Rd.  
**LOS ANGELES 6, CALIF**—B. J. Shadon, 2202 Wilshire Blvd.  
**ANNIST CITY, OHIO**—A. J. Sullivan, 310 F. C. Rd.  
**ST LOUIS 31, MO**—P. O'Brien, Lambert Airport Bldg.  
**SKN DESIG 1, CAMP**—B. F. Cohn, 1341 South Ave.  
**WASHINGTON 3, DC**—A. J. Kelly, Jr., 377—14th St. N.W.  
**WEST DYER 3, MASS**—B. J. Chaudron, 150 Wilton Ave.  
**WICHITA 5, KANSAS**—L. E. Krasner, 220 E. First St.

control implement allows the pilot to walk to keep track of his vote. The all-purpose nosegear R-14A valve is adapted for both low-level and high-level maneuvers such as evasive banking, go-around and obstacle clearing and terrain clearance—regardless of visibility, ceilings or target area conditions. General mapping ranges of 11, 40 and 80 inch are possible. Under instrument conditions the rider can be used to eliminate doppler error.

The General Electric FC-5 flight control valve, tied to the doppler for automatic navigation, does the steering on a great circle course. The FC-5 incorporates autopilot, with loss of steering, will separate small corrections as the F-105 turns the vicinity of the target in clockwise (the autopilot also incorporates automatic coupling to RLS—instrument landing system).

## Fire Control

"D" model also incorporates the General Electric AN/ASG 19 "Thunder stick" fire control system, which includes the R-14A valve and a General Electric bombing computer. A Republic aircraft incorporating this computer allows an bombardment and other aircraft and being highly complex and light control systems with its control.

"Thunderstick" area and takes over the actual release of the bomb and solves such problems as release altitude, flight time to target, angle of attack and so on. In control modes of delivery the system also includes an escape maneuver following the bomb release. The three-axis automatic flight control (FC-5) functions as an escape control, in an effort to the pilot in both flight the jet or taking over completely.

Thunderstick bombing mode which keep control to a minimum include:

- Wingspread mode. This should be an escape maneuver to the horizon, not being horizontal. In addition, the cross wind increased in doppler is sent to the autopilot so that if the time of bomb release the wings will be level.

- Bomb release. Another and is the nosebombing computer which requires the pilot having to fly a pre-computed problem. The pilot can pull up the F-105 at any angle, the computer will compute and release the bomb at the correct time. If escape data is not correct, the bomb will release at high point rather than at low point.

- Escape maneuver. Direction which reduces time of flight of a bomb to a minimum, is the most accurate mode of delivery and recovery system in escape maneuver with use of a nuclear weapon. In this instance the computer often gives a release or release a point, depending on the "guide point."

• Vertical bombing. A low altitude (350 ft.) non-bombing reference system, for vertical bombing, is tied to the doppler for heading indication. It is also tied to the bombing computer for true vertical indication and this is in the flight control system so that the pilot automatically can maintain any heading bearing.

## Bomb Accuracy

Sophistication of the F-105D weapon system could allow for a circular error probable (CEP)—distance from target to average point—of about 500 ft., which is not surprising with the angle. A one kiloton bomb (25,000 tons of dynamite), with a 500 ft. CEP, could easily knock out any target. By comparison, a 1,000-lb. GEF would require four airplanes at a bomb four times the strength. An airplane with a CEP of 1,500 ft. would require a 10 kiloton bomb to do the same work. The F-105 is said to have the smallest CEP of all General Electric aircraft.

The Thunderstick can operate from 1,000-ft. down, with a dog check to slow the landing roll. Average take-off distance is 1,000 ft., landing roll, 1,500 ft. Without a dog check the airplane can turn off within 7,000 ft. Installation of a wing ejection system allows the aircraft roll about 900 ft.

Usual F-105 attack speed is about

**Thank You, Again...**



WILLIAM B. HODGINS

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 NATIONAL AVIATION BOARD MEMBER  
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## THEY RELY ON RADIATION

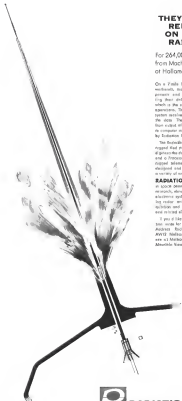
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from Mach 4 speeds  
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On a 7-mile long track, these sleek test vehicles, missiles, satellites, communications and home laboratories, tracking their data in a laboratory building which is the only one under air load operations. There, a digital information system receives, transmits and processes the data. The entire laboratory system is out of the test home laboratory is computer systems designed and built by Radiation Incorporated.

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**F-105** can carry three 450-gal. external tanks plus bomb bay loads. Airplane is approaching 2,000 mph. wings without folding.

175 ft. Final approach is down about 180 ft., touch-down is usually at about 160 ft., speeds varying with weights. Pattern speeds are comparable to the F-100, initial pitch-out speed is 150 ft. Two vertical and two horizontal dive brakes (jet-type), on full decelerate the aircraft, when the gear is down, the vertical brakes close up, permitting operation of the drag chute and preventing bottom-pitch-up moment, scraping. Fully open, at 50 deg. angle to leading, the brakes present an area of 29 sq. ft.

### Pilot Requirements

The 4th Tactical Fighter Wing at Seymour Johnson Air Base, "combat ready," is checking out in the F-105 as the precision of checking out in the F-100. "Pilot performance can't be mediocre," and Capt. Gary A. Willard, wing

training officer for the wing, who himself is commanding 1,000 hr. of jet fighter test lead a track pilot, test with whom the other less north is an F-100F. Capt. Willard noted that the 4th's F-105 pilot requirements generally run to 1,800 hr. total flying time, of which at least 200 would be in Century series aircraft.

The wing is dominated by captain pilots with an average age of 37 and an average individual flying time ranging between 1,500 and 2,000 hr. The wing is moving toward putting 25 hr. per month on each F-105. As a wing it is projected to fly a total of 1,800 hr. per month.

The 4th doesn't operate on the "variable" principle. If the "variable" principle, pilots would operate on about a 10-hour movement, which would hinge on reaching of aircraft, breaking

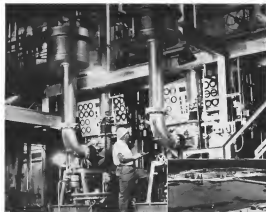
setting up aerial tanker movement, etc. The wing has just completed equipment tests with the Boeing KC-435 Stratotanker, which will be used when available. The 4th now uses KB-50s for aerial refueling. With two additional 450-gal. tanks, the F-105 still becomes a tanker for "buddy refueling."

Squadron pilot check-out and training runs to about 75 flying hours. It includes 10 transition missions of 2 to 30 min. each, plus a combat readiness program including day-night air refueling, special and conventional weapons training. Ground training includes a 16-day program, in addition to steady squadron programs.

Transition from the F-100 to the F-105 is paying out for the pilots at Seymour Johnson, Avonmouth, Wren was told. Wing maintenance personnel are trained by a mobile training detachment



**ARMAMENT** carried by this F-105F at Seymour Johnson AFB includes two 1,000-lb. F-55 bombs outboard and two 750-lb. Mk 83 bombs inboard. Canted under the belly is a 450-gal. external fuel tank. Long bomb bay will carry a nuclear weapon.



## How Liquid Hydrogen came out of the lab

These new high-speed turbo-expanders hold the key to producing Liquid Hydrogen on a tonnage basis. They make it possible to liquefy this ultimate fuel at low cost for the first time. Specially designed by Air Products for the Air Force Tonnage Liquid Hydrogen Facility at West Palm Beach, Florida, they are the latest examples of how Air Products experience and skill in cryogenics apply laboratory technology on an industrial scale, to meet specific requirements.

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...INCORPORATED



**Hinged** nose and access panel facilitate F-105 inspection and maintenance. Note non-rotated General Electric M41. Yellows denote that fast 6,000 revs. a minute.

stiffened at the base, as an pilot for system installation. Majority of the mobile detachment was trained at the Air Force school located at Republic's Farmington plant. Republic also has seven of its own technicians stationed at Serrano. Johnson came with each squadron, plus additional specialists looking up the consolidated aircraft maintenance (CAM) squadron.

Postflight and periodic inspections on the F-105 usually were pulled over 75 and 50 in. The Thunderbolt now has gone to 100 in periodically, with three special inspections pulled in between. Some aircraft have flown 50 straight flights with no maintenance required going into the periodic. Some have made in more as 60 landings before a line change. Engine changes, with line work, presently average about one day's time.

The F4HE, seven feet from the ground to the wing, with a "cigar-bottle" shape, incorporates all hydraulic flight controls, similar to present day, operational fighters. Throttle extension standard mechanical linkage (not an electronic line). A fuselage that at the base of the vertical stabilizer fresh cooling runs up to the air intake section between the tail pipe and dorsal. With landing and acceleration, 100 in. of additional fuel is gained.

The Thunderbolt differs both leading-edge and leading-edge flap in (a) most in. Series of dampers (stabilizer augmentation) give the aircraft optimum control, though it has been demonstrated throughout its flight envelope without these aids. Spoilers on the wings act for the aircraft at high speeds.

Variable air inlet ducts allow an evenness of air into the engine itself.

Hydraulic pressure for the tandem flight control servitors stems from two engine-driven pumps, each with an independent reservoir. Ram air turbine provides a third power source for flight controls. Should the fire protection be lost, the battery will supply enough power to operate the aircraft's entire electrical load for four to five hours.

Thank You, Again...

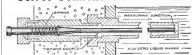


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## Sub-Zero Ceramo-COUPLE Solves Condensation Problems



"Ceramo" versatility has also solved a key problem of air zero temperature measurement—condensation. Caused by wide temperature differences between ambient temperatures and the thermocouple measuring point, condensation can produce thermocouple insulation and short out conductors.

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Write for Bulletin 52-C

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LONGITUDINAL arrangement for takeoff/landing was used for the first time in the USSR on the Yak-24. The helicopter's aerodynamic equipment permits it to make flights at night and under difficult weather conditions. The Yak-24 project was initiated in 1952.

## Soviet Flight Techniques Detailed

Alexander Yakovlev, a major Russian aircraft designer, detailed Soviet management techniques for high priority projects and technical problems involved in designing the Yak-24 helicopter in his secret book, "Tales of an Aircraft Designer." The following excerpts from the book provide an insight into how the Soviet Union runs a design project in technical areas where it is lagging, including the firm direction and pressure required to speed to meet a deadline.

During the three decades of its existence, our design bureau has concerned itself mainly with fighters and training planes. Therefore, when newspapers published the report that a gigantic helicopter—"flying railroad car"—had been built by our design team, it created surprise in aviation circles both at home and abroad.

The history of the "flying railroad car" development is somewhat unusual.

At the end of the summer of 1952, I was summoned by the government. On arriving at the Kremlin, I met Tupolev and Il'yushin there, and also the helicopter designers Mil, Kamanov and Brudnikov. I was surprised at the unusual combination of designers who had been invited. Helicopters and airplanes are such different craft and have so little in common that helicopter builders and airplane builders rarely meet together.

But everything was cleared up at once in the conference began. It turned out that they had invited us altogether in order to get advice. How could our country, disavow its then existing lag in the field of large helicopter construction?

Actually, at that time we lagged behind the United States of America in this field. We were told that the design forces working on helicopter construction were insufficient, that this matter

must be dealt with seriously, and that the government had decided to ask experienced design teams in the airplane manufacturing field to engage in a project that was somewhat unusual for them—to help to build large, multi-place helicopters.

Michael Lomontschik M.I. who had been engaged in helicopter construction for many years, came forward at this meeting with a prepared proposal based on an already-developed design for a



SINGLE-ENGINE helicopter developed in 1952 by the Shkolovsky Central AeroHydro dynamometer, demonstrated a model altitude record of 6,615 meters (21,697 ft.). The dynamometer provided important assistance for the Yak-24 project.

12-place helicopter. As far as airplane builders, the presentation of the problem was unexpected.

Andrei Nikolaevich Tupolev and Sergei Vladimirovich Il'yushin declined that in view of the enormous workload already being carried by their design bureaus, and also because of their complete lack of experience, they could not participate in helicopter construction. When we then came, I said that we, too, were loaded down with work, but that we had certain ideas about helicopters. During recent years we had built two small experimental helicopters. If we were given certain assistance, we could consider developing a draft project for a large helicopter. I asked permission to consult with my co-workers and to give an final answer only after that. This gave us 24 hours to think it over.

After returning to my design bureau, and without losing the matter aside for even a minute since we knew we had less than 24 hours remaining, I sent for Nikolai Konstantinovich Korotkiy, who had been working with aerogears for 30 years, Peter Dmitriyevich Semenov, a veteran in airplane building and a most experienced organizer, Leon Mikhailovich Shukhin, and Igor Aleksandrovich Brilikh, who was at our time the leading designer of our experimental helicopters.

### Difficult Task

I explained the essence of the matter. We possessed depth. Everyone thought the task was vague and "fuzzy." We realized the difficulties which were associated with the building of large helicopters in the United States and England. Yes, and it was impossible to build our own experience successfully.

Our work, with small, experimental craft was one thing—building a gigantic transport and cargo craft was quite another matter. But, since the government had made the request, and since "it is not so difficult to do things as it appears," we decided to undertake development of a design for a 24-place, two-engine helicopter. We consulted and concluded that the design might be accomplished in a year. Reaching this conclusion, the meeting broke up.

We were again called to the Kremlin the next afternoon. Among the designers, only M.I. was there. The other took a turn that was entirely unexpected for us, and for me, in particular.

It was suggested that we continue and give our impressions regarding an already-prepared, government-formulated project for building two helicopters. Construction of a single-engine, anglelevator craft carrying 12 persons was handed over to M.I.'s design bureau; and the two-engine, two-rotor craft accommodating 24 persons was



YAK-24 has carried a four metric ton payload to an altitude of 6,521 ft.

Alexander Sergeyevich Yakovlev is an aircraft designer in chief under the USSR Minister of the Aviation Industry and a Colonel General in the Engineering and Technical Service. With no formal technical education, he began his professional career in a laboratory as an engineer and studied aviation in his spare time, primarily under the auspices of the Society of the Friends of the Air Force, a Soviet paramilitary organization. The first aircraft he designed was a biplane test plane in 1927. His design bureau has three major flight design groups flying in World War II. Design has created today include light aircraft, helicopters, all-weather fighters and ground attack aircraft. Yakovlev has twice been awarded the title of Hero of Socialist Labor. He is a member of the Communist Party and a deputy in the USSR Supreme Soviet from the Kuybyshev District.







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## Kinetics design shrinks missile switch from 50 lb to 7 lb



As shown in this bottom view, the motor switch is much smaller than the bracket. Switches can put a 300-grm. motor-driven switch on less than one cubic inch.

The original main power changeover switch in the Atlas missile that switched from ground supply to air-launched electrical supply just prior to launch weighed 50 lb. Now, thanks to the design ingenuity of General Motors engineers who ask the number of reasons from 25 to 39 and to Kinetics Corporation, engineers who provided a new design concept, the switch and bracket assembly weighs only 7 lb. Once a panel of settings in the missile-chamber weight adds about a mile to the missile's range, this saving is truly spectacular.

The new Kinetics motor-driven switch is more rugged and reliable than previous designs and is superior to shock and vibration. A typical Kinetics switch withstands no contact chatter over the whole vibration spectrum, from 5 to 2000 cycles, 49 G's. The

voltage drop across typical switch contacts is less than 10 millivolts at 50 amp. The high-density design results in many circuits per cubic inch, saving space. There are no permanent magnets or springs, no latching device. This is truly a motor-driven switch using no elements of relays. The switch can be transferred to 40 G's, 2000 cycles. Once it's transferred, no power is required to hold it in position, saving batteries. Write or phone for more information on how this switch can be adapted to your requirements. Kinetics Corporation, Dept. K-11, 410 S. Golden Avenue, Sylmar, Calif. SKtype S-11RL.

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system. Helmer worked very long and agonizingly to perfect the Bristol craft, but he was unable to achieve reliability in flight or to see his machine go into mass production. The British were forced to buy in America a British to build the Sikorsky helicopter.

(The Bristol Scout helicopter, on which Helmer was the principal designer, was under development during the late 1940s and had entered service in substantial numbers by 1952. Bristol also sold the Scout to the British. Production of Sikorsky helicopters in England was begun by Westland in 1947-48.)

At the beginning of the nuclear era, all known American and British helicopters had comparatively small lifting capacity—a limit of one metric ton. Only the Pavesi first widely abundant in proposed two to three-ton YH-16 helicopter. However, great underdevelopment designer Pavesi. The craft was under construction for a very long time and its design could not cope with the vibration which developed even during flight and while hovering at low altitude. After eight years of persistent work, YH-16s were used for flight tests. But it was an unfortunate craft in 1953, on its 23rd flight, it fell to pieces in the air, and its entire crew of five men perished in its wreckage.

(Pavesi YH-16A crashed in 1953, after its two crashes. The reason for its crash had been under development for some time before it crashed in 1953. In 1953, Pavesi built two more—the YH-16 with two piston engines and the YH-16A with turbine engines. The two helicopter met its flight test of ground effect before the YH-16 crashed. Another was found to be a bearing in flight test equipment. Company engineers maintain that engine vibration had been eliminated and was not a contributing cause of the crash.—ED.)

### Vibration Problems

Pavesi taught successfully for many years with vibration in the YH-16 helicopter, and Helmer spent many years in trying to cure vibration in the Bristol-173. Vibration was the most distressful and difficult to cure malady of all helicopters. We also saw convinced of this in terms of our helicopter was designed and built and began its flight tests at the airport.

(While an helicopter has over been completely free of vibration, company engineers report that they have seen no serious difficulties with the Bristol-173 since it went into service with the Royal Air Force more than two years ago.—ED.)

During the entire process of our design bureau, the main objective of the mission was speed and more speed. From aircraft to aircraft and from test to test we strove to put our planes greater and greater speed. But for helicopters, on the other hand, the main thing is not speed but the ability to

have members in the air and to have speed, lifting a large load vertically from the ground.

We utilized an original helicopter design—one which was to be used for the first time in our country—a dual-rotor craft with longitudinal positioning of the rotor along the helicopter's axis. This arrangement, as we later confirmed, had advantages as compared with a single-rotor design, such as a helicopter is more stable, it lifts a larger load, and above all, its cargo capacity is more spacious, thus permitting loads of greater dimension to be lifted.

We had no experience at all with regard to the chosen design. Therefore, we had to start everything from the very beginning. We were forced to make a large number of the most extensive investigations and had to solve difficult scientific and research problems with the help of scientists in the Zhukovskiy Central Aero-Hydrodynamical Institute and the Moscow Central Scientific Research Institute for Aircraft Engines. The most qualified people were brought together. The coordination of design experience with deep scientific research, which was carried on in every branch both in the own all design and in developing individual components. But when the helicopter was built and started its tests—checking of all the systems and all the working parts—it was demonstrated that every problem in such a complicated machine could not be foreseen by theoretical means. More new problems arose—for example those connected with cooling. A long engine is exposed to a blowing stream of air, and the engine is extremely cooled, but here we had to make a helicopter hover for a long time in one place while carrying a full load. So it was necessary to provide forced cooling for the engine. But the main difficulty, which provided us with a heap of trouble, was vibration.

The Ministry of the Aviation Industry devoted much attention to the helicopter projects—both the NII-1. Broad organization was organized among the various factories. The Ministry gave the "green light" for manufacturing helicopter parts at other aviation industry plants. The work progressed rapidly.

First copies of the helicopter were built at once. The first copy was for testing static strength in the laboratory. The second was for checking dynamic strength at the airport—that is, for checking the resonance (twice the) when the engines and rotor are operating and the helicopter is in suspension on ropes.

The third and fourth copies were for three- to better and government tests. Positive results in testing one of the four copies in an actual practical condition is a better one of the others. For example, the last copy, which was intended for static tests, was seen the

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Hydrex Company Long Island developed the "Molegrade" for Piers and Marine Corps use.

Glyndyne Company, Long Island, called on Alcon to help with a vital aluminum transmission housing for the coaxial-type rotor system of this compact, rotary-wing aircraft. The Alcon team selected a high-strength aluminum alloy and developed a composite mold (plaster and sand) for the casting. An Alcon-developed chilling technique insured high strength in critical areas. The result? A transmission housing that gives better than 1,000 hours of service.

Critical nature of this part called for mechanical properties to meet Class I specs of MIL-C-21180 . . . requiring 38,000 psi tensile, 28,000 psi yield and 6 per cent elongation. The casting also had to be pure to hardness weight.

Other aluminum castings for the "Rotarycycle"

case with its secondarily pass all the tests put to it. But the second cognitive domain testing can be tested, worked over and refined for several years. The British and American experience spoke eloquently to us about that.

Besides the tests I have constructed and which were conducted at our plant, some parts of the work were checked at other factories and institutes.

For example, the entire business vehicle was tested at the motor plant where it was manufactured. The Slader was tested for vibration stability at the Zlatokorski Central Auto Hydro-mechanical Institute, where this was given 10 million oscillations in order to be sure of their stability. The entire motor group, with the engine test section and the cooling, was tested at the Baranov Central Scientific-Research Institute for Aircraft Engines. All of these tests were carried out simultaneously, as a whole, and in the allotted period of time.

[illegible]

## Service Tests

It was necessary to conduct 300-hour service tests in order to check on the reliability of all the helicopter's parts prior to test-flown flight. We tried to put the stretched 500 in as the prototype craft as far as possible. The approach was that if these tests were successful, the helicopter was not just a segment of what was to come, it was the aircraft, and it was necessary to start the test not from the beginning—there were. Then, with a very additional hour of the writer's attention, we reported on the use here while, on the other, our greater anxiety arose within as a question: *shouldn't we?*

After 110 he woke me up, we were able to cope with the radio's shaking and vibration. We started with trepidation the results of each new hour of operation which brought the tests to the sacred figure "300." Although confusion had built up that everything would be all right. Then, suddenly one day a urgent voice came over the telephone from the airport:

"Big trouble! The craft has been demolished and is on fire. It's urgent."

able to save anything. The case is un-  
lessed.<sup>22</sup>

"How are the passengers?"  
"Nobody has been hurt."  
I quickly drove out to the airport.  
A sad picture appeared before my eyes.  
There was a pile of burnt wrecks  
and mangled bodies scattered around  
the area. Nothing more was left  
of the aircraft. It had run up a total  
of 178 ft. It was necessary to start ex-  
cavating from the beginning.

An accident investigation consisting of the most prominent spectators, and with us participating, finally determined the cause of the misfortune. It turned out that burning waste on the inside of the motor engine had led to too high a stress. The motor engine and combustion pan, along with the rollers, fell forward, and the blades began to clap up the entire craft. Careless boat makers got tanks grafted onto the hot engine, and for looks' sake

I consulted an astrologer by seeing that at least it was fortunate that the cause of the accident had been determined. Nuclear insurance would be taken which would mean there would be no rejection of the trouble in the future. In addition, everything which had already been started up to the 175th mark, didn't go to waste either. Finally, that's what script says as well.

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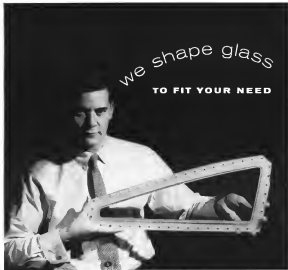
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For complete data on Eds Model 309 Laser,  
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—to reveal such defects in time.

But conclusions are only conclusions. And Libbey was considerably departed. There was nothing to do but start the tests with redoubled care, especially since we had already prepared the first firing cups of the helicopter for flight.

Away from the flight registers, the charts and radio operators, a flight test crew was named consisting of test pilots Sergey Gromovskiy, Broshov, and Igor Filipovskiy Mikheevich.

Broshov had 11 years' experience in a very experienced helicopter test pilot. Mikheevich, who was young and capable, had just just begun testing work. But the Broshov-Mikheevich combination was, as it turned out later, an exceptionally fortunate one.

#### Fast Flight

After the very first test flight in the helicopter, both Broshov and Mikheevich spoke well of the craft. But there were still small pumps, flights and landings at an altitude of 5 to 10 meters above the ground. The pilots tested the machine carefully, trying thoroughly to get it right.

The helicopter's landing designers were always present during such tests. I discussed all the test results in detail with the pilots and other designers. We worked very carefully.

Hundreds of small flights, lasting several minutes each, and reduced engine power had been made since Broshov at last announced that a real test flight could be attempted. And we, after discussing all of the previous flight results, decided that such a flight might be made.

When Broshov and Mikheevich had taken their seats in the cockpit and prepared for flight, they gave the test pilot (myself) for the first time the status report: possibly, and the machine, throwing out a hurricane stream of air, lifted the craft off the ground. It flew the way it should, straight, gained altitude and took forward. All three percent of this large, modern helicopter were under my control.

All of us—designers, workers and pilots—had believed in the helicopter for a long time and knew that it would finally fly. But when it actually did fly, we all knew no longer.

After 30-35 sec. of flight, the pilots landed safely. We shook their hands and could not do without the track record filled of champagne.

However, both of the pilots soon became rapidly disturbed and began to talk, essentially about the appearance of a kind of "cold shivering" in one condition of flight. Special, sensitive, in-between recording equipment was installed on the helicopter. As a result, it turned out that, in several conditions of flight, there was not a "cold shiv-

## Yak-24 Design Details

Several versions of the Yak-24 helicopter have been built, and the aircraft is still being improved. Yakovlev explained a number of the main features of the design development to Ralph Alex, head of component design at the Helicopter Aircraft Division of United Aircraft Corp., when Alex visited the Soviet Union in 1960 as president of the International Helicopter Commission at the Fédération Aéronautique Internationale and attended the 21st general assembly of the FAI in Moscow.

Yakovlev's discussion of the Yak-24 and Alex's forthright observations indicate that the design was initiated by borrowing two of the 50-60 rotor, the rotor hubs and two L750 hp Turbomeca engines and their transmission from the Mi-4 helicopter in order to make a rapid development program possible. Originally, the Yak-24 design was made of welded steel tube construction and covered with fabric. The latest version has an aluminum fuselage with a new 75-60 disc rotor with the blades made in sheeting short metal pocket sections to a steel tube spar that forms the leading edge.

The cabin design, which is now experimental, uses rotor blades having a rounded steel tube spar with built-up short metal aerial sections around them. Main purpose of the new design changes is to increase the short take-off capacity of the aircraft in the civil version; the goal is to carry 40 civilian passengers.

Yak-24 is considered an all-weather helicopter and is equipped with windshield and blade deicing, rotor alternator, UNIP radio, electric artificial horizon, wing-mounted flight instruments and a re-lighted instrument panel. The automatic stability system, which is standard, is a development of an aircraft system and does not function below a forward speed of 40 or 50 km/h. Development of a new system which will operate during the hover is planned. Descent rate of the Yak-24 is electrical, in contrast with the alcohol system used on earlier Soviet helicopters which did not prove satisfactory. Forward speed is powered at 120 km/h, and the maximum speed at 167 km/h as the Yak-24 suggested by Alex. Single point operation is provided for both control surfaces, and tracks up to five tons have been done. A new landing gear for internal loads is power aided. Maximum allowable center of gravity level is 40 in.

Alex said that all important features of the Yak-24 test design pointed to easy maintenance and long life. The rotor hub is ultrasonically tested. The flying hinge is located near the hub centerline, the dog links extend neither eight inches up or so. The blade mounts are taken out by two solid ball-bearings outside of the dog links, and the control links are covered by a control shroud housing. All gear and necessary assemblies on the turbine engine, which resembles the Wright R-1525, now known that could be U.S. standards. The Russians explained that by using that rigidity in gear and necessary assemblies were the most important factor in good component life. Accident officials also indicated that no new equipment was considered ready for service until it had a 1,000 hr. life.

ing," as the pilots distinctly expressed themselves in an apparent effort to warn the designers that a very real and intolerable problem which caused dangerous vibration of the structure.

For five months we searched for ways to eliminate this shaking-free months of serious studies and calculations. There was too much experimental flight, and all without result.

Here it is necessary to keep in mind one of the differences between a helicopter and an airplane. With an airplane, winging and turning parts operate only in the engine, and all of the vibration which develops are absorbed in special shock absorbing devices. But, with a helicopter, anything can be the source of vibration. One major danger is the other engine shakes the rotor disk, the synchronous connecting transmission between the rotor shafts. A very great amount of time was required to discover the primary source of the vibration. It was not actually, as I've just fighting the helicopter's vibration device as to a state of resonance.

lation, depression and even head-on-attack. After we began to find that we could even control the vibration more it appeared unacceptably in various places. It got to the point where, instead of solving problems, we were met by the shaking, we started at once to meet it. "How is it going—still shaking?"

"It's shaking, it's shaking!"

"Where will this damned shaking stop?"

The Zhukovskiy Central Aero-Hydrodynamic Institute and other scientific research institutes, under the direction of Deputy Minister S. N. Skolnikov, who led the information work on the helicopter, gave us good assistance. From the Soviet Academy of Sciences, in Moscow, A. I. Malinovsky, head of the Zhukovskiy Central Aero-Hydrodynamic Institute, gathered together everyone who might be useful in order to discuss with all of them the entire range of the vibration problem. Several months later there was a common meeting. In that discussion, Malinovsky, who was known

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Canadair Forty Four photographed in flight November 15, 1961

**GENERAL DYNAMICS CORPORATION**



**DESIGNER** Mikhail Ml was assigned the project for the single rotor M-4 at the same time Yakovlev was ordered to build the two rotor YB-24. Cruise version of the M-4 with Ansatov markings is there here on a movie screen

well a prominent specialist in the aircraft structures strongly field the chief of the strength and vibration laboratory I. V. Ananov, assemblers worked B. P. Zhuravskiy and I. S. Vildiyev, and several other prominent and thick-headed sought the shortest path toward overcoming the helicopter's dangers and difficult "fliers."

But there were also some scientists who took the opposite road in their analysis. They detected their scientific traditions and technical knowledge in search of more convincing proof that the vibration was inevitable and that in general, we were fighting an inevitable disease.

One of them, an irascible doctor of technical sciences with a very typical appearance—just like in the motion pictures—brought with him previously prepared diagrams and, walking about the assembly terminology, formulas, and figures, proved that we would not eliminate the vibration since it was an inherent defect in this helicopter design.

#### Proposed Solutions

Many and varied hypotheses and suggestions were advanced on what had to be done and how to "tame" the all-vibrating helicopter. Some suggested that the helicopter be made heavier, others that it should be shortened. A third group proposed building a triplane of new design and a fourth took of opinion that he believed that no matter what was done, it wouldn't work. To inhibit their staid they advanced this argument:

"The Americans couldn't get rid of vibration in the YB-16. Either couldn't do anything with the Bristol-177's vi-

bration. Are you the sturdiest one of all? Don't waste our time for nothing."

But we didn't waste our time for nothing.

If we had just one nerve and had leveled blades in their without checking it by experiments and if we had not analyzed the conditions of occurrence in the light of engineering experience, it is possible that our helicopter wouldn't have been in existence in this world. But inhibited by faith in our own experience, and leaning on the support of such scientists as Ananov, Vildiyev, and Zhuravskiy, we finally found the correct engineering solution. And here is how it came about.

#### Vibration Source

In furthering recall and hearing are heard over just what the source or in danger of this vibration was. I came to the conclusion that it was necessary to try to cope with the vibration through the separate elements.

I am "tormenting myself" because this really was torture. Neither during the daytime nor at night, neither in the theater nor when I was not far a walk, not even at dinner did I thought about the incessant vibration issue on hand.

Occasionally you get distracted a little, but suddenly a thought about the vibration would permeate your whole being, and you would breathe break into a sweat from a feeling of impotence, from seeing some insurmountable obstacle that was confronting you. And then, on one occasion, a thought came in me that of all the possible sources of vibration, the main one, and the

most dangerous, was the blades. There are four main blades on each of the helicopter's rotors—a total of eight. This all turns at constant speed, as compared to the emergence of very complex mechanical and aerodynamic phenomena.

#### Blades Shortened

And what would happen if we changed the vibration characteristic of the blades? In order to construct myself whether the vibration came from the blades, I suggested that we try cutting off half a meter from each blade and see how this would affect vibration in the whole structure.

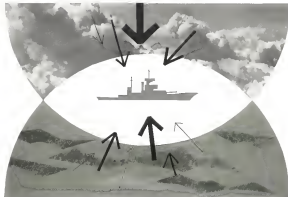
Again we all met together—Stukov, also, Likhachev and others. We discussed the proposal from all angles and decided that we had nothing to lose.

In two weeks, blades that had been shortened in 50 centimeters were mounted on the craft. Everyone waited. What would happen? The engines were started, the blades turned, the pilots went in the cockpit. Brothers made the signal "everything ok," and the craft stood upright.

Brothers and Mikhaylov remained in the air for 20 min. We didn't know how the helicopter had performed, but judging from the smiling, pleased faces of the pilots as they hopped shore in and down, approached the ground, we surmised that there had been some results.

What general delight there was when Brothers and Mikhaylov declared peace, first, and in answer that, during the 20 min, they had indeed felt some unpleasant signs and all flight signs, and that no traces of the shaking remained. It was one of those plain surprises which, as designing work, sometimes forthwith, confirm the advantage of common sense, engineering over philosophical and scientific schoolmasters. To be sure, in the course of subsequent tests, a large number of different defects were found up and down. But the same was, yes, a vibration, and we had just not to it.

The helicopter was presented for government tests at the beginning of the winter of 1957. It would have seemed that everything would now be in order. But fate had prepared yet another blow for us. The military pilots never even allowed to make 10 flights under the government test program before there was an accident. During one of the tests at full cruise power with the craft cut down and only a machine in the cockpit, one of the in-down cable broke, then another, a third and a fourth. The craft shot upward. The machine, being unable to control the helicopter, did the only thing he could, quickly cutting the throttle. The helicopter, being unable to rise more than six-eight meters, turned over on its



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side and crashed to the ground. The altitude was low, so there were no casualties. But the craft was put completely out of commission.

It was terrible. The accident had a depressing effect and even haunted some well-known engineers to quit the helicopter project. Fortunately, the main engineering crew—Sundstrand, Kellogg, Denney, Oglethorpe and Hamilton—didn't budge.

We had a second flying copy of the helicopter, and we turned it over for maintenance of the government tests, after first strengthening the tail-drum cables.

But the test on our nerves wasn't over even after we had presented the craft to the Scientific Research Institute. Maybe it was because we had spent so much time on the vibration problem, or because the prototype machine had been dismantled and rebuilt, and the first flying copy had crashed after breaking loose from the cables. At any rate, the Scientific Research Institute at first showed a distrustful attitude toward the helicopter.

The first months of its tests at the Scientific Research Institute were a continuous nerve strain for us. This was so because Scientific Research Institute personnel demanded that we take the helicopter back for refinement of every little detail and even defect they found, even though, in a safe, each fairly smoothly accompany the testing of our new machine.

There is a difference in the spirit and fundamental problem-solving of the helicopter as a piece of engineered equipment built to perform a definite mission—was delivered. Several months passed, and only 15 or 20 flights were made.

And then, one day, our mission equipment, including our helicopter, was shown to the heads of the Ministry of Defense at an airport near Moscow. It was very cold. The generals gathered together. They examined the heap of lights and sensors that was on display, and finally the whole party approached the helicopter. Everyone quickly climbed into its huge cabin to escape from the piercing wind. About 20 people gathered in the cabin.

The aircraft, hanging in the air for commander's risk.

"Well, how's the helicopter? How are the tests going?"

"Well, they aren't doing it as much as they are breaking with it... The craft is great—no doubt here. The design staff has to do a lot of work on it the first of defects... etc., etc."

The marshal interrupted him. "Stop indulging in bureaucracy. We don't need a lot of defects. A few machine can be directed to a lot of it. We need the helicopter! Keep



TWIN-ENGINE HO4S designed by L. F. Sikorski was developed in 1939-40. It had "good flying performance which quickly evolved that shown by previous helicopters."

this in mind. The craft is either suitable or it isn't—that's the important thing to determine. And in regard to changing defects, come to some understanding with the designer. Remember that this is new technology, something we've not used to."

## Tests Are Completed

As a result, in four and one-half to two months, the helicopter's test was completed. During this period, several times as many flights were made as in all the previous time. Co-workers in the Scientific Research Institute, test pilots S. G. Il'yushin, P. I. Shabanov, V. I. Korotkiy and K. D. Tsvetkov, and captains A. M. Zagladin and S. Kh. Alibekov put in a lot of work and displayed their heroism in testing the helicopter. They gave us every satisfaction in speech concerning the craft's development.

Finally, after the test were over and the helicopter received a favorable rating, the government accepted it for serial production under the designation Yak-24.

We continued working to improve the craft after serial production began. In particular, the helicopter's control mechanism was improved.

The control system was still very expensive, and the slightest misalignment in rigging or warping of the fuselage in flight could cause objectionable vibrations. But then, while aerial gunnery performance was under way, our specialists succeeded in making a noticeable improvement in the control system for large helicopters which completely removed all doubts about control reliability.

This was the last important refinement in the helicopter. After that, we located more body and it became quite easy to breathe after four or five hours made the first public flights at the 1953 autumn parade in the presence of many specialists, especially the foreign aviation specialists

who were present at the parade. And now several months about the helicopter craft.

The Yak-24, in its external appearance, looks like a tubular train or an electric train.

And actually, it is a rail railroad craft. Up to 40 passengers at a more speeding speed of 200 km per hour. The cabin is 10 meters long and about 2 meters in width and height. It holds up to four tons of aerial cargo, including large-dimension items such as two-ton GAZ 60 or Pobeda automobiles. They go into the helicopter under their own power by means of a ramp in the tail section of the fuselage.

The cockpit, located in the helicopter's nose section, is a reliable fireproof structure. From here, in case of a failure, it is possible to see everything that happens on both sides and below. Even conditions for making the helicopter crash is not even less important. The helicopter's crew consists of a pilot in a flight machine and a radio operator. These are dual controls. The main controls and pipes are mounted compactly on panels in front of the pilot's seat.

## Yak-24 Advantages

What are the Yak-24's main advantages as compared with other types of aerial craft?

Stability and ease in controlling the craft, land-landing capacity and speed of horizontal flight—these are the main problems that every helicopter designer strives to solve successfully.

Without increasing speed, we've increased load-carrying capacity sharply. That is the chief and distinctive virtue of the Yak-24.

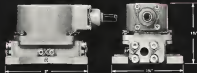
The longitudinal management for rotor positions was used for the first time in the USSR on this helicopter. That huge rotor blades were also located on the nose and tail sections of



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the fuselage. They turn in different directions. They are driven by two powerful rotation engines, connected by a synchronous shaft. If one of the engines goes out of commission, the other will run both rotors, and the helicopter will be able to continue its flight.

In turning, the rotors, which are horizontally positioned above the fuselage, turn the helicopter off the ground and lift it into the air. But how does this craft change over to horizontal flight?

By moving the control stick on the front seat, the pilot operates the tilting rotors' "automatic mesh plates." These change the pitch of rotation. The rotors are tilted to the right, to the left, forward or backward. When the rotors are continuously tilted in one vein, the helicopter acquires horizontal motion in the desired direction. Turning the craft is achieved by tilting the rotors to different sides.

#### Flight Capabilities

What are the flight capabilities of this craft? What can it do?

Milvatches took a four engine test load to an altitude of 9,523 ft in this helicopter. It carries a loaded 10,000 lb. with a two-ton load. They demonstrated the craft's "ceiling" and load capacity. These results were confirmed at world records in 1956 by the Federation Aeronautique Internationale. In 1955, the load carrying records were exceeded by a gigantic new Russian helicopter—the Mi-6.

As for the Yak-24's endurance in the air and flying range without landing, this is testified by its many long flights, in particular those on the Moscow-Leningrad route which were begun by pilot Y. A. Gerasimov. The newest navigational equipment permits the helicopter to make flights at night and under difficult weather conditions.

#### Complementary Vehicles

In conclusion, it must be said that the airplane and helicopter are not competitors. They are built with different purposes and uses.

The more advanced the engine becomes, and the higher its speed and load-carrying capacity, the more it is "tied" to the ground. It requires runways and more durable runways for takeoff and landing. Such runways can't be built everywhere.

As for the Yak-24 helicopter, it needs an area only a little larger than that for takeoff and landing. It can deliver people and cargo to places where neither a train nor an automobile will go. Under rigorous Arctic conditions, in difficult-to-reach mountain areas and in the boundless spaces of the tundra, this craft can do work that is beyond the capabilities of other types of transportation.

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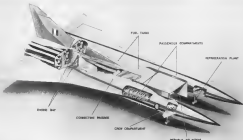
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ARTIST'S conception of a British Siskind supersonic vehicle has combination thrust-jetboost engines mounted on the tail section and fuel tanks in outer fairings. Note positioning of passenger compartments and delta wing configuration.

## British Envision Ducted Fan VTOL

By John Tynan

London—First details of British Siskind's BE-53 powered VTOL aircraft (AW Dec 14, p. 35) show winged and wingless propulsors with the ducted fan, lift/thrust engine and alone, and in combination with clusters of pure lift engines.

Development of these supersonic vehicles, both in helicopter applications or as transport aircraft, was backed by S. G. Hucker, technical director of British Siskind, Egnance, Ltd., in a talk before the Institution of Mechanical Engineers here.

Hucker said Britain has lost its lead in the jet transport field and the only continental engine jet transport still has gone to the U.S.

### Future Powerplant

But he claimed that apart from supersonic applications, the low compression ratio, lightweight, ducted fan engine of the BE-53 type could supplant turbojets as the medium range engine bracket within the next decade. This engine formed the great bulk of the aircraft being and he named that without a government-backed development program to provide a suitable family of these engines, Britain would be swamped by Russia and the U.S. in all aircraft categories.

First applications of the BE-53 engine, thought to be in 15,000 lb.-20,

600 lb. thrust engines, will be the Hawker P.1127 VTOL strike fighter which is due to enter its first flight within the next few months. Mode of operation of this aircraft has not yet been disclosed but based on Hucker's description of a hypothetical military application of this type, the engine will be located in a nonvertical manner with other system horizontal and run

therefore be run up without creating ground effect.

For short takeoffs, the efficiency the ducted fan is discharged horizontally during initial accelerating ground run and is then deflected downwards to provide both lift and thrust responses. This arrangement prevents ingestion of ground debris. For true vertical lift the engine is run up to full



WINGLESS vehicle envisioned by British Siskind would have flying crane capabilities.

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These curves have been computed for a turbojet, above Mach 2.4; combined jet and ram between the two.

power before jet deflection to shunt gas flow in deflection areas.

An turbojet engine described by Hoesler has a gross weight of 55,000 lb and combines two 15,000 lb lift/thrust engines with smaller (10,000 lb thrust) ducted fan engines used solely for lift and shut-down in cruise. Hoesler claims a thrust-weight ratio better than 14:1 for both engine categories so that the weight penalty of the pure lift engines amounts to 3,000 lb.

With this penalty, Hoesler said, the aircraft could sit at cruise at subsonic speeds and carry a 10,000 lb payload.

#### Wingless Helicopter

The helicopter replacement proposed by Hoesler offers a simple aircraft totally sustained by the thrust from a single BE-53 engine discharged from four symmetrical nozzles capable of developing thrust for variable lift reaction. The vehicle would have twice the speed and six times payload in a conventional helicopter. With all advantages including a parachute capable of sustaining the complete vehicle in the event of engine failure, a fuel and payload figure of 45 tons was quoted for a vehicle powered by a BE-53 of 34,000 lb thrust, and capable of 350 kt air speed.

According to Hoesler calculations, a smaller VTOL transport with a small wing just capable of sustaining the aircraft at maximum cruise would show a 60% advantage in range compared with a conventional aircraft of the same take-off weight, due to weight savings in wing and landing gear structure.

At speeds below cruising, speeds jet deflection would be used to suppress lift.

The BE-53 engine, which has three times the bypass ratio of the Rolls Royce Conway, has a specific fuel consumption of 0.6 lb/hp/hr and thrust-to-weight ratio of 14:1.

Raising the compression ratio will eventually drop this consumption to

0.5 lb/hp/hr. Hoesler claims that this type of engine will be the major part of the conventional engine industry effort in the 1960s. Afterburning in the fan stream will lead to very large thrust boosts and makes the engine suitable for supersonic speeds.

Hoesler showed that thrust/weight ratios of turbojets had dropped from wartime figures of 2 lb thrust/lb weight to ratios exceeding four for large engines like the 40,000-lb General and around 6 lb thrust/lb weight for the comparatively smaller Olympus engine.

Most guarded feature of the BE-53 is design of the variable nozzle used to direct exhaust. The company is believed to have an air-caged nozzle system including multi-pivoted elbows, such as used in medieval armament tests. But most practical arrangement from engineering considerations is likely to be deflection of the bypass flow into turns ducts parallel to the same system. Each branch of the bifurcation can then be latched in a relatively simple linear bearing so that it is free to rotate in the vertical plane. This arrangement allows the jet blast from the latched to the vertical, covering all takeoff and cruise conditions.

Extending the deflection a few degrees beyond the vertical gives a substantial thrust component for landing purposes.

The advantages of supersonic thrust by afterburning in a ducted fan engine would suggest the likelihood that the bypass flow and the hot gases are exhausted through separate nozzles common in the P-1177.

#### United Research Plans Engineering Center

Menlo Park, Calif.—United Research Corp., a subsidiary of United Aircraft Corp., plans construction of a research and engineering center and a development and test center in the Santa Clara Valley on the San Francisco Peninsula.

The research and engineering center will include three structures—the administrative and engineering offices with executive offices in the administration

#### Lufthansa Plane Losses

Bonn-Lohrstedt (UPI). Gen Josef Kammhuber told a parliamentary defense committee that 26 German jets have been lost since the German air force became operational in 1957. Of these, 39 were Republic F-105s Kammhuber said, including two which recently crashed in Czechoslovakia.

In reply to questions, Kammhuber said radio tracking sets are being installed at Lufthansa institutions.

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building, the research laboratories and the development laboratories. Development and test center will include facilities for a solid propellant development plant and extensive test facilities for both solid and liquid rocket engines. Both vertical and horizontal test stands will be included, as will instrumentation facilities for acquiring data.

United Research has outlined the following four general areas of technical work:

- Research in advanced high performance solid and storable liquid propellants for thrust and endurance power
- Development of high performance solid and liquid model engine systems
- Research in thermodynamics, combustion, physics and materials
- Provision custom studies for optimization of power plants for weapons and space systems

## PRODUCTION BRIEFING

Japanese Defense Agency has ordered a quantity of Bristol Siddeley Orpheus 805 turbojets (4,000 lb. thrust) for the Fuji T-12, standard intermediate and advanced trainer for the Japanese Air Self Defense Force.

AeroProducts acquisition of Allison Division of General Motors Corp. will

develop a 7.5 ft. twin-blade turbopropeller for the T200g, Alouette T20 engine. The Model 272 propeller will have variable governing, manual and emergency feathering, aluminum hub and blades, ice control and full-enriched plastic spinner.

Multi-million expansion program is under way at Cessna Aircraft Co.'s Industrial Products Division, which is expected to ultimately cost some \$4 million. A 110,000-sq.-ft. addition to the main factory, Hutchinson, Kan., is 95% complete; a new 18,000-sq.-ft. experimental laboratory and a 30,000-sq.-ft. engineering building are also being built, with completion scheduled for this fall. The facility has employment of 100,000 sq. ft. needed sales of \$10 million in fiscal 1959, up 70% over 1958.

General Electric YB54 afterburning powerplant for Republic's Q-1B target drone will undergo series of extensive ground tests at Van Nuys, Calif., to confirm engine compatibility with airframe subsystems and to facilitate Republic personnel with the engine's operating characteristics.

Aircraft Research Assoc., Bedford, England, plans to construct a wind tunnel with 3 ft. diameter for Mach 8.9 studies. Completion is scheduled for next year.

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## Tunnel Diode Applications Investigated

By Barry Miller

New York—Tunnel diodes are starting to fulfill some of the promise which their developers have been claiming for them as they are being designed into a widening variety of experimental circuits.

A series of applications for the new diodes (AW Aug. 17, p. 73) appears to be in computer circuits—in which they are introducing substantial improvements in switching rates and for which their small size and low power consumption are particularly well suited.

Some results of a Navy-supported investigation of ultra high speed computer logic and memory circuits at Radio City of America were outlined

in reports to the Eastern Joint Computer Conference by Leo A. Rayburn and Martin Loran. Included in these papers were descriptions of three basic tunnel diode logic elements—two binary, one monostable—which can store, amplify and gate.

One of the basic logic elements consists of a single tunnel diode driven by a current source and coupled to inputs and outputs from a point above the positive terminal of the diode. Normally in the low voltage or "0" state of this characteristic, the diode can be pulled by the current source beyond the threshold current to the high voltage or "1" state where it remains until it is reset. This change of state enables the diode to provide current cancellation in succeeding stages.

The current generator can be adapted for a specific logic function. Thus, with proper adjustments and for one or more "1" inputs, the output can be "1" (low gate) or when all inputs are in the "1" state the output can be "1" again (AND gate).

Logic elements can then be grouped and clocked by overlapping pulses. One experimental unit demonstrating this type of logic and containing 27 tunnel diodes was built at RCA according to Martin who, along with Arthur Lo, directs much of this work at Rayburn.

It contains a storage loop, a full adder stage, shifting means and other functions. Designed with only one, complementary diode stages and driven by a three phase clock at one megahertz, the unit when of 50 nanosecond switching times (where one nanosecond equals a billionth of a second).

A second bistable or balanced circuit consists of two tunnel diodes with pulse or monostable signal applied across them. Their complementary characteristics and the diode's current reversal and superposition on the other one, with one curve reflecting the load curve for the other, provides for two stable operating points. A pulsed or monostable input from the circuit across these lines sets one or the other diode into the high voltage "1" state.

Input voltages at the junction between the two diodes trigger one of the two diodes, against the voltage rising that point and effectively amplifies the input signal. Like the previous bistable units, these elements can be coupled externally at their subpoints and grouped to form logic networks.

### Diode Limitations

The monostable logic element uses a tunnel diode in series with an inductor. With the diode biased to a point just below the maximum current on the threshold of the negative resistance region, Rayburn says. A small voltage triggers the diode to the high voltage state from which it is automatically reset back to "0" by the voltage induced in the inductor. Here again sets can be mutually applied state logic subunits.

One of the most serious drawbacks to the tunnel diode, Loran says, is that it is not a saturated device. Because it has only two terminals, both input and output are at a common point. Consequently, it is necessary to couple the diode to other devices through a resistive device such as a rectifier (whose slower speed would nullify against its



CHARACTERISTICS of an silicon antimonide tunnel diode placed in a square photo die containing liquid nitrogen are checked (left) at Bell Telephone Laboratories while studies (right) closely focus volt-ampere characteristic of a germanium tunnel diode.



as, in some instances) or for monostable applications a full effect isolator, gate or inverter. To the RCA logic technologists using the logic elements are tested previously, time separation is achieved by multiple phase clocking.

Another aspect to this problem, Loran adds, is to maintain these bistable and monostable characteristics. In the monostable circuit, tunneling can be interrupted between tunnel diode stages.

To overcome possible problems posed by the bistable logic gate or the out of the tunnel diode, the transfer of elements a single diode can drive—diodes with sufficient characteristics are essential. Unlike high gain transistor devices, variations in the low-gain diode cannot be anticipated with logic gate design. This will require high yields of tunnel diodes matched to within 10% or a relaxation of recent tolerance requirements and lead applications.

### Random Access Memory

Ten nanosecond cycle time random access memories that are necessary to go along with the anticipated one nanosecond tunnel diode logic cannot be obtained easily from magnetic recording as Rayburn. Consequently, RCA has selected the tunnel diode for memory systems despite the large number needed and its interception at full scale production of the device.

Each bit, Rayburn says, is stored by a current driven tunnel diode with two stable voltages.

Any diode can be properly set by pulses from other adjacent elements which are mutually coupled and arranged on row and column lines. Coincident bit or word addressing requires

ing two-bit and three-bit selection discrimination, respectively, can be used.

Rayburn claims that the logarithmic dissipation rate and low power dissipation of the tunnel diode will permit a packaging density of 80 or more elements per cubic inch. Thus, computers with almost theoretical logic and several tens of thousands of memory elements can be incorporated into a volume with a two-foot diameter. Propagation delays can be kept down to one nanosecond because of the close proximity of the diodes in compact structures.

These techniques can lead to better but per second information handling structures, Rayburn says.

### Tunnel Diode Penalties

Possible applications of tunnel diode in parametric amplifiers for straight-through amplification and frequency conversion is also receiving attention at RCA. A 400 mc down converter circuit has both gain and low noise a

combination heretofore unobtainable in a down converter, has been developed and reported by K. K. N. Chang.

In this device, according to Chang, a 450 mc local oscillator beats against the 400 mc input signal across a gallium antimonide tunnel diode and produces a 50 mc 100 signal. The converter has a measured noise figure of 1.5 db, Chang says, and also provides 25 db gain.

### Mixing Possible

Nonlinearity of the diode makes the mixing possible and the negative resistance is the source of gain.

This resistor losses both conversion gain and low noise compared with a crystal converter, and low noise compared with a down converter by a parametric mixer. More gain is required of the tunnel diode converter, however, because both a local RF oscillator and a d.c. biasing source are necessary.

Local oscillator signal addition back through the antenna leads to be true-



SINGLE ENDED bistable tunnel diode logic element is biased in "0" state at point P at left. Diode can be pulled into "1" state by shunted current source in circuit at right.

## Tunnel Diode Background

Tunnel diodes are heavily doped p-n junction diodes which have a negative resistance region in a forward-biased voltage characteristic (AW Aug. 17, p. 73). The device derives its name from the quantum mechanical tunneling phenomenon by which electrons "tunnel" through the forbidden band of a semiconductor junction to create the unusual negative resistance feature. The device is sometimes referred to as the Esaki diode after Leo Esaki, Japanese scientist who observed and explained the tunneling effect in germanium about two years ago.

Negative resistance of the tunnel diode often is characterized in two ways. In the two-terminal device, typically, in the forward region of the characteristic curve, the current rises to a peak, then drops to a valley and then again like a conventional diode characteristic. Values of peak and valley currents in one germanium unit are 1.1 milliamperes and 0.4 milliamperes, respectively.

- Some reported features of tunnel diodes are:
  - Extremely high speeds, limited principally by junction capacity and carrier transit times.
  - Oscillation frequencies in the kilocycle-per-second range have been reported.
  - Ability to meet modern microwave requirements that of the transistor and vacuum diode because the diode's mechanism does not require high purity crystals and isolation devices to the extent as in an assembly.
  - Negligible thermal and current generation power output is involved by the diode's short voltage drops which are a function of the energy gap and the degree of impurity in the semiconductor material.
  - Insensitivity to humidity variations.

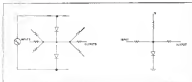
- Ease of fabrication suggested with isolation because of the absence of surface problems, structural complexity, and freedom from elements for high purity crystals.
- Operation over wide temperature range because of low thermal doping and presence of potential temperature ranges with high energy gap materials.

Principal applications are expected to be in computers to perform such functions as amplifying, gating and switching. A function arises from the action of a two-terminal diode—for used to provide direction of signal flow. In the converter region the diode may be used when low power requirements are needed. Engineers, however, claim the ability of the diode used in a microwave amplifier to give gains again comparable to those of parametric amplifiers or valves.

Problems in making the diode suitable for use in a microwave amplifier in packaging, the control of doping and difficulty in handling and fabricating high-frequency rectifiers whose use becomes smaller at the higher frequencies.

Tunnel diodes have been made from germanium and silicon as well as except of the group III-V compounds such as indium antimonide (Bell Telephone Laboratories) and gallium antimonide (Radio City of America).

The diodes are now available on a limited supply quantity basis from several manufacturers, including General Electric Co. and RCA.



**BALANCED** diode bridge logic element (left) has one or the other diode in "I" state, determined by polarity of applied signal. Movable diode at right meets itself by voltage induced in inductor.

biomass and must be filtered out. It can also be reduced by increasing the frequency separation between the input and local oscillator signals. Substituting a 215- $\mu$ s pump in the same device, Chang operated the converter again with the IF output filter between the second harmonic of the oscillator and the input. Chang hopes to eliminate the local oscillator entirely.

Stright-through paramps—those in which the output signal is the same as the input—have been operated without an RF pump (4.2  $\mu$ s) in the energy source.

Tuned diode paramps are not frequency sensitive like the reactive paramps, Chang says. He hopes to push their operating frequencies well up into the microwave range.

Higher frequency diodes imply reduced RC time constants to which the frequency is inversely proportional. C is the junction capacity and R is the resistance of the junction. As the area of the junction is reduced, C tends to decrease while R increases at the same rate, thus halving the product of the two constants. Thus, reducing the area and length, increasing the doping increases the speed of the diode but also drops the diode's impedance. The peak current, which is a function both of doping and the manufacturing material, is increased in the process creating the midsize problem of supplying a high current power supply. Ideally, then, Lewis says, it's desirable to reduce the time constant without altering R. One long-term way of doing this, he explains, is follows: Reduce the area while reducing C and increasing R, but dropping the peak diode current. Then if the doping is increased, the diode's peak current is reduced, its characteristic is essentially the same in time, but C is reduced while R is unchanged. This process can be repeated, and the time constant is shortened by greatly reducing C.

Series resistance of the diode and inductance of the leads and mount can't be ignored in these time constants must be kept well up to RC.

Bell Telephone Laboratories indicates an interest in tunnel diodes for microwave applications but expects that device technology must be improved before tunnel diodes turn out appreciable power. The diode becomes smaller and harder to handle at the higher frequencies and the output power decreases as the fourth power of reciprocal frequency.

RCI currently has been working with silicon semiconductor tunnel diodes which presently must be cooled to liquid nitrogen temperatures. These diodes have low junction capacity and should have high frequency response and high current densities. High current density may provide an answer to the need for higher power.

Extreme tunnel diode circuit applications have been presented at General Electric Co. also. Recently, Robert N. Hall, a GE scientist active in tunnel diode development work, described a single tunnel diode receiver in which one diode successfully performed the functions of an RF amplifier, local oscillator, mixer and first IF amplifier.

## NEW AIVIONIC PRODUCTS

### Components & Devices

• **Gold-plated capacitor** for microelectronics and other miniaturized electronic products: protection against corrosion and case soldering. Units have 0.5 in. interconnection, less than 0.25 in. contact withdrawal force, less than 0.005 ohm contact resistance and conforms to Sigal Corp. Specification SCJL-0230, according to the manufacturer. Moked Electronics Co., 335 East Pine St., Philadelphia, Pa.

• **Solid-state** three delay switches, in three basic types, are designed to handle up to 10, 16 and 50 amps, respec-

tively, without arcing, contact damage, radio interference, audible noise or vibration. Operating voltages are 24-110 vdc for units in black anodized aluminum case 11 in. diameter, 2 in. long. George Harrison Co., 15232 Parthenon, Hawthorne, Calif.

• **Subminiature rotary potentiometers** ranging in size from 1/4 in. in diameter to 1 in. are in 200-10,000 turn/hundredfold units offering up to 200C and capable of withstanding 100  $\mu$  vibrations. Models vary units have high sensitivity, good noise level and self-cleaning capabilities. Components line of rotary potentiometers



shaft torque of 3 in.-in. and friction clutch for precise settings, can be mounted in two places without additional fasteners. Subminiature Instruments Corp., 3705 Seaplane Drive, Redwood, Calif.

• **Transistor chopper**, type 6825, with self-contained drive transformer, has split switching action for operation over chopping range from 50 to 5,000 cps. Drive may be 6.3 volts square wave or unmodulated, with less than 25 mva. power required. Signal outputs up to 100 v. with constant up to 10 ms. can be handled by 1-in., 0.75-in. diameter by 1.675-in. long unit in area to 550 temperature range, according to manufacturer, Aquas Electronics, Inc., Cambridge, Md.



• **Plated wire inducting grom**, M2531 02, designed to be mounted directly on frame of antenna or aircraft, provides inductance of 0.025  $\mu$  and regular inductance of 250,000  $\mu$  in. cm. up to 1000 feet from vertical (dip is 0.01 deg./hr. and azimuth drift is 0.42 deg./hr. Keuffert Co., Inc., 1980 Main Ave., Glenside, N. J.

# Systems Analyzer Speeds F-101 Checkout

By Philip J. Klein

**MANASSAS**—First production models of Honeywell-Henrichs new automatic systems analyzer for the McDonnell F-101B, which has four test cells, automatic self check and repair, to check out and troubleshoot the airplane's flight control system is 80% completed with latest manual test equipment has been delivered to the Air Force.

First model will be used for F-101B flight control checkout, but the basic design is universal to all possible applications. The specific tests, measurements and checkout sequence is controlled by perforated Mylar tape program.

This permits the analyzer to be used with a variety of aircraft in numerous systems shops, operating parameters can be measured electronically.

The Honeywell analyzer is designed to automatically introduce, in logical sequence, a series of known a/c in the signals and to measure the steady state or dynamic response of the system to such signals. In addition, the device can switch in simulated actuators, simulators or indicators, into circuit under test. It also can supply simulated loads, watch protection signals and eliminate switching facilities for connecting subroutines into test demand configurations.

In its design approach, Honeywell has aimed primarily for reliability and simplicity, rather than for high speed and sophistication, a corporate policy says. The analyzer carries out such techniques like introducing test signals and making measurements digital before programming and without. The analyzer can perform an average of approximately 60 tests per minute. It is priced at less than \$200,000.

### Prototype Model

Prototype model, evaluated by the 70th Test Squadron at Wright AFB, has operated for a week of 24 hr. work out, a single failure—no self-checking. The USAF report on the Honeywell analyzer evaluation, prepared by Capt. Alfred H. Uhlir, Jr., project officer, says the equipment "proved to be highly accurate and reliable in an extreme test office found in this type of equipment. During the evaluation the test set accurately handled all in circuit and actual flight malfunctions, except for 6.

Use of the test set reduced average flight time (single-checkout time by an estimated 90%, and, in many cases, eliminated a functional check flight). This represented a considerable savings in man-

power, flight time and dollars," the report concludes.

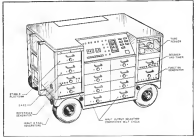
The Honeywell analyzer is available either as a stand-alone console or mounted in a trailer which is air transportable. The mobile version can be used either on the flight line or in a

base maintenance shop. Its mobility permits analyzers to be shifted from shop to flight line or vice versa as required.

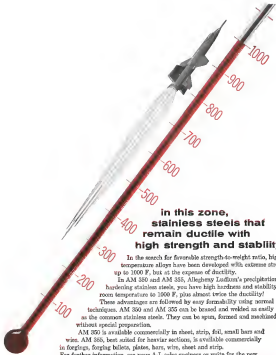
The analyzer proper occupies about 40% of the trailer volume. The remainder is used to house cables for



**HONEYWELL** automatic systems analyzer, shown in set up on an F-101B, will be used to check out and trouble-shoot flight control system and air data computers on F-101B. Air Force tests indicate new analyzer will slash checkout time by at least 50%.



**MOBILE VERSION** of the analyzer, which is suitable for flight line or maintenance shop use, includes trailer and reinforced top to permit its use as a work stand to give access to airplane's mission equipment. Analyzer is operated from perforated tape.



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AM 350 is available commercially in sheet, strip, foil, small bars and wire. AM 355, best suited for heavier sections, is available commercially in forgings, forging billets, plates, bars, wire, sheet and strip.

For further information, see your A-L sales engineer or write for the new technical booklet, "AM 350 and AM 355." Allegheny Ludlum Steel Corporation, Oliver Building, Pittsburgh 22, Penna.

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connecting into the airplane's mission equipment and to store spare modules for replacement of defective analyzer elements on the spot. Top of the trailer is mechanical and covered with an aluminum walkway so it can be used as a work platform, with access provided by a small ladder at the rear.

Like most automatic checkout equipment, the Honeywell analyzer will automatically check itself immediately after detecting a fault to determine whether the trouble is in the airplane's mission equipment or within the analyzer itself.

The analyzer also performs a self-check sequence prior to making a detailed trouble-shooting analysis of the airplane's mission equipment.

A significant advantage of any automatic checkout component for trouble-shooting is the fact that it always uses the same well-planned sequence of tests regardless of the operator's skill level, which in the long run is the perfect way to isolate the fault.

In contrast, the sequence of tests followed by maintenance personnel using manual tests depends upon the skill level and intention of the technician involved, the size (or difficulty) of making a specific test, and on his recent experience with the equipment. If a specific tube or other com-

**Thank You, Again...**

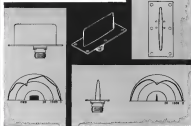


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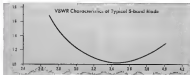


**HI ASPECT  
RATIO  
LO DRAG**

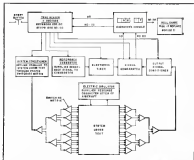


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**DIAGRAM** of thermocouple analyzer shows how tape program controls switching, test signals and compression of sensor output. Analyze units both analog and digital techniques.

prement has been a recent troublemaker, a thermocouple must smoothly replace these stress first in his effort to locate the trouble.

The use of an automatic analyzer also means that the same standards are consistently applied in evaluating whether a system is satisfactory, in gauging satisfaction, removing the element of human judgment.

#### Readout Device

A digital readout device on the Hinescoff analyzer indicates which test is being performed at any instant. If malfunction or misperformance is detected, this is indicated by a red light and a two-digit numerical code. Operator refers to a roll chart corresponding to test number and fault number for instructions on what fault has in the airplane, should be repaired or what other corrective action is required.

The Hinescoff analyzer uses a Miller-type program with 16 links. (Only the first five of these provide the address; the remaining 11 specify signal output, output and allow the reference. Tape is driven by a selected mechanism at rates up to 15 lines per second.)

The perforated information is cut by a tape reader and transmitter decoder into switching signals which connect required signal generators to correct paths in the circuit and connect in appropriate signal generators required to provide a reference signal with which the system output signal will be compared.

If output signal is within prescribed

limits, computer generates a "pass" signal which automatically advances the program tape to the next test instruction. If the signal is outside of specified limits, the analyzer first checks its own internal operation. If it finds no internal fault, it then transmits a signal to operator's console which causes it to display a two-digit number indicating the specific malfunction of the system under test. Operator then consults the built-in roll chart to determine what corrective action he should take.

In high performance areas, systems used in flight control, a static test is not adequate for determining whether system performance is satisfactory. To perform dynamic system checks the Hinescoff analyzer contains a wave-form generator whose frequency can be varied on request and a digital timer which can provide a precision time base that is programmable in 25 second increments.

Both the static and field test version of the Hinescoff automatic test system analyzer employ modular construction with major subassemblies mounted on removable drawers.

Hinescoff has orders for 18 of its QGS-747 analyzers which will be used by 1-0113 squadrons, according to Charles F. MacNeil, product manager in company's ground support equipment department. Hinescoff currently is negotiating for sale of a similar analyzer to West German Air Force for use with its Lockheed F-106C, to check out airplanes flight control, inertial platform and air data computer

#### 00000 FILTER CENTER 00000

►Thermomagnetic Generator Before DuPont-North Research Laboratory study of thermomagnetic generator, which transforms heat directly into electricity, indicates its efficiency is too low for development into a useful device. Report on the NRL study, entitled "Efficiency of a Thermomagnetic Generator," identified PB 151736, can be ordered from Commerce Department, Office of Technical Services, Washington 25, D. C., for 50 cents.

►Cut Eye for Night Photographs—A light amplifier kinoscope recorder equipped with a single stage intensifier pickup tube has achieved a sensitivity equivalent to an ASA number of 10 million. Report on the "Light Amplifier Kinoscope Recorder for Night Photographs" by Wright Air Development Division Aeronautical Research Laboratory, identified PB 151914, can be obtained for 50 cents from Commerce Dept., Office of Technical Services, Washington 25, D. C. Another report in the same group entitled "Positive Detection of Celestial Bodies Using the Interferer Image Overlay," identified PB 151566, also is available at 50 ps per copy.

►Computers Linked by Microwave First has been installed to transmit data from North American's Aerospace Division in Canyon Park, Calif., to a battery of six large IBM computers at the company's main plant at Los Angeles International Airport. 10 mi. away, which also will be linked to communications with NASA's Manned and Astronaut Divisions at Denver, North



#### Recovered Recorder

Rugged sensitive type recorder, intended for a T-38, also now covered under Atlantic Ocean, specially prepared with technical design tips of its power, testing and data recording from captured reconnaissance jetman. Manufactured by Ampex, the tape recorder weighs 20 lb., records two tracks of information on a five-inch tape.

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Americans was this: its first four years saw bids have been used to transmit data to control equipment. Transmission rate is 5,000 words per second.

► **Transmitter Sales Climbs**—Sales in September of 8.7 million transmitters set an all-time monthly record according to figures released by Microwave Industries Asia. Total sales for the first nine months of 1979 were \$7.9 million as compared with \$4.4 million for the same period in 1978. Dollar sales for the first nine months were \$154.3 million as compared with \$77.2 million last year.

► **New Piping Concepts**—Monitors made possible (Monitors) offers several attractive advantages over conventional materials for piping transmission and other electrical devices. Bell Telephone Laboratories scientists reported during recent National Conference on Application of Electrical Insulation in Washington, D. C. When Monitors is used, damaged components can be replaced by cutting out on cut and joining parts by the granular dielectric powder. Other Monitors advantages include no expansion or contraction over a wide temperature range, insulating temperatures above 1,000°C and no aging or softening required.

► **Cleveland Cathode Support**—Cleveland Cathode Support made of molybdenum (molybdenum) which was

a standard feature of Solvay-Lowry Products, Inc. order cathode anodes, improves overall efficiency and life of the tube, the firm says. Unusual shape of the support sets out of contact between cathode and support in bulk and thereby reduces tube degradation and speeds ramping time.

► **Signed on the Dotted Line**—Major contract awards recently announced by aerospace manufacturers include the following:

- **Kennel Co.**, Little Falls, N. J., \$100,000 study contract for a solid-state multi-head optical computer intended for space navigation from Wing Air Development Division's Weapons Guidance Laboratory.
- **General Electric**, Inc., Military Electronic Department \$118,000 study contract for Monitors launch control system communication techniques from Boeing Airplane Co. GE, one of five companies to receive study contracts for the program, will investigate low, medium and high frequency systems.
- **Schwartz Research Laboratories**, Basking Ridge, N. J., will develop solutions to detect alien and compounds intended to be obtained temperatures above 5,000°C and a \$278,000 research and development contract.
- **Electronic Research Corp.**, Stoughton, Mass., has received a \$73,334 contract for investigations of the optical navigation system to be used on Polaris-bearing submarines.



**Airborne Tactical Data System Developed**

Airborne Tactical Data System (ATDS), AN/AQ-54 developed by Navy, software and wiring and control circuit will provide surface ships with prompt action data on attacking aircraft and also permit AEWAC aircraft to guide fleet weapons toward the targets, according to the intercept path directly. Developed in Little Rock, the AQ-54 is the first ATDS to be developed. It will be flight tested by Lockheed on a WV-2. Configuration System includes digital computer, data processor, display, and communication equipment. Smaller lighter version of AQ-54 is being built for use on carrier-based aircraft. Smaller version is under development for the Marine Corps.

AVIATION WEEK, December 26, 1979

## FINANCIAL

# Boeing's Allen Cites Trend to Mergers

New York—Economics of the future point toward mergers and consolidation in the U.S. aviation industry, according to those under way in Boston, William M. Allen, president of the Boeing Airplane Co., told the New York Society of Security Analysts.

The tactics used in Britain—forcing consolidation by government fiat—are not likely in the U.S., Allen said in response to a question, but companies might be put in a position to do so.

Over the long haul, Allen said, commercial aviation should be rewarded, influenced by continued growth of air transport, improved aircraft efficiency and the potential growth of an airport that Allen estimated would be at least tenfold by 1970. In addition, he forecast substantial improvements for military air cargo aircraft in the 1980s.

Public forecasts indicate a two-fold market for 1,800 small, medium and large turbine aircraft worth about \$7 billion in 1979 dollars, Allen said. Boeing's share of the 565 turbine-powered airplanes on order or delivered in 1978-79—having a total sales price of \$2.5 billion—has been 195 airplanes or

professor pursuant to will occur soon to occupy these costs, lightening competition and resulting in terms on who which, standing alone, make no economic sense.

In his view, he declared, there is not a sufficient market for additional sales to permit a reorganization of losses suffered by the remaining airlines, terms within the foreseeable future. Boeing's total 707 jet transport services are \$134 million in debt.

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approximately 34% of the total. Allen said there will be increasing emphasis on smaller, unmanned air craft and sophisticated active vehicles, but he also expects a continuing and substantial replacement for manned aircraft. Specifically he cited reconnaissance and early warning aircraft. The B-57 might be adaptable for such use, and he also pointed out the possibilities of the KC-135 as an electronics platform.

### Verbal Manger

Talking on Boeing's own terms in mergers, Allen noted the proposed acquisition of Votrol Aircraft Corp. by your Boeing as entry into the V-510C, field (AW Nov. 25, p. 25). Allen said Boeing was looking at other new fields for the company but held promise for the future, but that merger or acquisition would be considered only if the necessary capabilities could not be obtained economically and readily enough from within the company.

One example might be electronics. Allen said the company has developed an electronics capability for special



**Boeing Develops Manned Tracking System**

Visual Angle Tracking Capability system (MANTRAC) has been developed by Boeing Airplane Co. for use in areas where SAGE or automatic electronic systems are not available. The system allows triangulation on a Plessey map, each photo is linked to a number of data sets by phone. Information is relayed to a fighter or missile controller.

AVIATION WEEK, December 26, 1979

Engineering Report  
ON BENDIX COMPONENTS

The top section of the advertisement features a stylized illustration of a person standing behind a desk, with the text "Engineering Report ON BENDIX COMPONENTS" above it. Below this, the main visual is a large, detailed illustration of a Bendix motor component, showing its cylindrical body and internal wiring. To the right of the main component is a smaller, detailed illustration of a Bendix component, showing its cylindrical body and internal wiring.

- SPECIFICALLY DESIGNED FOR RIGID AIRCRAFT AND MISSILE PACKAGING AND PERFORMANCE REQUIREMENTS
- ACCURACIES WITHIN 1/10 OF 1%
- TEMPERATURE RANGE FROM -55°C. TO +125°C.
- LIGHT WEIGHT—AS LOW AS 7 OZ.

Supplied in frame sizes 11, 15, 16, and 23—with size 16 now in development, Tailoring to customers' needs also available—for example, with unitized construction requiring no external compensation and with pulse generators for direct indication of speed measurement.

Baseline	1.0 g (1.0 mL) of 100% THF	THF only
Sensitivity	1.0 g (1.0 mL) of 100% THF	1.0 vol% per 1000 MHz
Phase	1.0 g (1.0 mL) of 100% THF	0°
Temperature (°C)	1.0 g (1.0 mL) of 100% THF	-55°C to +85°C
Injection position (mm)	1.0 g (1.0 mL) of 100% THF	2 mm
Injection	1.0 g (1.0 mL) of 100% THF	0.1 mL

Eclipse-Pioneer Division  
Tucson, N. J.

Quarterly Office: Rockdale and San Francisco, Calif.; Seattle, Wash.; Boston, Mass.; and New York, N. Y.  
 Lloyd Jones & Lawrence Rood, Indianapolis, 228 E. Ohio St., New York 17, N. Y.

Westland's profits as of Sept. 30 were \$3.87 million. In its previous fiscal year ended June 30, 1958, total profits were \$1.93 million. After deductions, there was a net profit of \$3.58 million, an increase of \$1.82 million over 1957-58. Dividend has been doubled to 12%.

It is important that SBA members have had to watch the Defense Department award production contracts based upon their incentives to their competitors.

As a result of this contradictory federal patent policy, I feel sure that "hundreds" of small business men have already reduced research and develop-

ment expenditures to compensate for the loss of their own research in order to expedite the proprietary positions which they must have in order to compete. It could

Small businesses are in most instances dependent upon a proprietary position of some sort whether it be patents or trade know-how for their

Eclipse-Pioneer Division

This is the twenty-sixth of a series of advertisements dealing with these facts about alloy steels. Through much of the information is elementary, no believe it will be of interest to many in this field, including men of broad experience who may find it useful to remove faults made from time to time.

## Cold-Finishing of Alloy Steels: The Effect of Cold-Drawing

The cold-drawing of alloy bars was discussed in the previous advertisement, No. XXVI in the series. Here, we continue with a general explanation of the effect of cold-drawing.

During the cold-drawing process, certain changes take place in the steel structure, and in mechanical properties. There is a slight increase in tensile strength, compared with a substantial increase in yield point, and a decrease in ductility. These properties enable the production of small parts which require the greater strength necessary for certain automatic-machine forming operations, and a machine finish superior to hot-rolled material. Naturally, the beneficial effects of alloy steels are attained in the subsequent heat-treatment of parts.

The process of cold-drawing results in bars which are free from scale, accurate to shape, and within close tolerances. These conditions are ideal for automatic machining, as the elimination of scale is conducive to long tool life, and the accuracy of shape and close tolerances permit the bars to pass freely through the feed mechanism of the "automatic." Moreover, the cold-drawn finish and tolerances may be such that machining can be eliminated in some areas of the finished part. For example, sparking wheels

are produced from hexagon bars which require no machining on the hexagon sections.

Continuous roller hearths and carbon bottom furnaces of both standard and controlled-atmosphere types, are used for special treatment of alloy bars before cold-drawing. Thermal stress-relieving can be used to reduce residual stresses in the steel caused by the cold-drawing process, wherein the mechanical properties will be altered depending upon the temperature used.

If you would like more specific details about the chemical composition or mechanical properties of cold-drawn alloy bars, and the results that can be expected, by all means consult our technical staff. Bethlehem metallurgists will gladly help you work out any problem, without cost or obligation on your part.

Remember that Bethlehem produces a wide and complete range of cold-drawn alloy steel bars in rounds, hexagons, squares, or flats, in standard, cold, decimal or metric sizes required, as well as special sections. Bethlehem also makes the full range of AISI standard alloy steels, and special-analysis steels and all carbon grades.

BETHLEHEM STEEL COMPANY  
BETHLEHEM, PA.

Steel Division  
Bethlehem Steel Export Corporation



**BETHLEHEM STEEL**

continued existence and future growth. They could not survive and grow if forced to compete with unaided big business in an open, fairly competitive market."

The use in favor of giving the government full title to all government-owned inventions was presented to the subcommittee by D. H. Baugh, professor of economics at the University of Maryland, Baltimore and.

"We are faced with the unenviable situation in which the federal government taxes the citizens of this country to secure funds for scientific research on the grounds that research promotes the general welfare, and then turns the results of such research over to some private corporation as an incentive, monopoly bars. The prospects to public freedom for private privilege is a joke, that is clear in violation of the basic tenets of our democracy."

### Acquisitions and Mergers

On Madison Chemical Corp. has acquired full ownership of Alstotra, Inc., by purchasing a controlling interest from the latter. The latter is an aluminum extrusion plant at Nagsburg, Pa.

Electroquip Corp.'s proposed merger with Controls Co. of America will be submitted to stockholders of both companies Dec. 28. Under the proposal each five shares of Electroquip common stock will be converted into six shares of Controls Co. of America common, resulting in issuance of 312,480 shares of Controls stock. Electroquip is a Chicago manufacturer of electromechanical control switches and assemblies, vacuum switchgear, and control panel assemblies, of illuminated switches and indicators. Controls Co. of America manufactures automatic control and is located in Schiller Park, Ill.

Barr's Intertec Corp. has made an agreement for acquisition of Polytechnic Research and Development Co., a producer of microwave test equipment for advanced work in communications, from the Polytechnic Institute of Brooklyn, N.Y.

Chasulley Corp., White Plains, N.Y., has acquired Western Corp. of America, Yonkers, N.Y., producer of bars, angles and flanges compounds, special tool materials and other machine tools.

Lock Corp. has purchased the Electronics Division of Prudis, Inc., Van Nuys, Calif., which manufactures static testing, testing and assembly

drag downs. The acquisition will be combined with the Leahy Radio Division located by G. L. Russell, general manager, but will function as an operating division with Walter D. Sullivan as manager of operations.

Midland-Ross Corp. of Cleveland has purchased Surface Combustion Corp. of Toledo, Ohio, including its Industrial Assets Division in Cleveland and Ohio. Federal personnel, policies and operations will remain unchanged. Midland-Ross produces automotive components, process industries equipment, heat-treating equipment for glass and metals, and atmosphere control equipment. Federal produces heat treating ovens, pneumatic controls and dust equipment, combustion and liquid heaters.

### Financial Briefs

Radstone, Inc., Melbourne, Fla., has filed a registration statement with SEC seeking registration of Certificates of Interest redeemable in cash. The company is offering to purchase 27,000 shares of its Class A common stock, together with the underlying Class A shares. In 1953 Homer R. Dimes, president, and George S. Shaw, vice president, sold to Kohn, Loeb & Co. and Johnson, Lane, Spence & Co. Inc. convertible options to purchase at \$16.50 per share an aggregate of 27,000 common shares. Subsequently, converted into 27,000 Class A shares of Radstone. Interest in the options are now controlled only by Certificates.

of interest which are transferable. Kohn, Loeb & Co. has transferred all its interest in the options to various of its partners and certain other persons. Business control holders must sell the certificates of the Class A shares upon exercise thereof. Radstone has undertaken to register same.

Acetech Laboratories, Inc., College Point, N.Y., has purchased the 567 million test cell facilities at the General Electric Laboratories of Fairchild Engine Division at Deer Park, N.Y. Purchase also involves acquisition of Alconet stock of Fairchild. Consideration of Acetech's First Engine Division and its new Advanced Propulsion Division at Deer Park will be effective the first of the year. L. D. Berman will be chief engineer of the new division.

Electronics Capital Corp., San Diego, Calif., has purchased \$400,000 senior convertible debentures of General Electrodynamics Corp., Garland, Tex. The debentures are convertible into 475 of General Electrodynamics common stock. Proceeds from the financing will be used for working capital to fund the company's increased backlog and for its continued growth. Electronics Capital Corp. is the nation's largest small business investment company and the first publicly owned. General Electrodynamics designs and manufactures precision electro-optic devices and is a prime contractor to the FAA for some electronic tests.



**USMC to Evaluate Anti-Tank Missile**

Colossus lightweight anti-tank missile, developed by Raytheon Production Co. of Norwalk for the West German army, will be evaluated by U.S. Marine Corps next month (AW Dec. 23, p. 35). Colossus has range of 2,000 yards and travels at maximum velocity of 194 mph. It can be fired from the ground and is water-guided from a small control box; conditions may serve as tracking platform. Missile is 30.7 in. long.

## COMPARE THE COMANCHE'S CABIN

**YOU'LL SEE WHY IT'S THE MOST COMFORTABLE  
SINGLE-ENGINE BUSINESS AIRPLANE FOR YOU**



The Piper Comanche far outshines all other single-engine, affordable general business airplanes. Why? Performance, price, reliability, rugged construction, of course. Superior comfort, too.

Smart aircraft purchasers know that comfort is perhaps the most important factor to check. A cramped cabin, with shoulder rubbing shoulders... knees nudging knees... can make a trip seem twice as long. Only the Comanche gives you the comfort you want for the money because you'll "live" in your surplus. Extra inches all around give added room where it counts.

### NEW COMFORT FEATURES FOR 1960

**NEW SEATING COMFORT.** New Squablon reclining front seats. New padded head rests.

**NEW CABIN AIR SYSTEM.** New rear cabin heater, new side view defrosters. Completely new, quieter 30-volt air system.



ATTRACTIVE LEASE  
AND FINANCE PLANS

**PIPER**

AIRCRAFT CORPORATION

EDGE MORTON, PENNSYLVANIA

Generous baggage space and allowance are yours, too. Only the Comanche gives you a large 20 cubic foot baggage compartment, with 200 pounds allowance. Biggest total load, too.

When you compare performance, comfort, price, operating and maintenance costs, your logical choice is the Comanche—either the super-economical 180 horsepower model or the over-three-mile-a-minute Comanche 250 (both have Lycoming engines, world's finest).

See and fly the new 1960 Comanche at your Piper dealer's or write for new full-color brochure, Dept. W-14.

## WHO'S WHERE

(Continued from page 13)

### Changes

Capt. George F. Book, manager of flight test, American Airlines Test Management and Engineering Center, Tulsa, Okla.  
Philip J. Kosa, director of planning (Bellman Engineering Corp., Los Angeles, Calif.)  
Joseph H. Hunsinger, director of color and related communications, Technical Liaison Division, National Company, Inc., Malden, Mass.

Hughes Aircraft Co., Culver City, Calif. has announced the following appointments:  
David A. Hill, manager, Spacecraft Development Division, Hughes Products Group, El Segundo, Calif.  
Scott, manager, Santa Barbara Research Center, a subsidiary, L. James Leveson, director of command, control office.

William F. Meadell, assistant to the vice president-commercial program, Douglas Aircraft Co., Santa Monica, Calif.

Rose Adams A. B. Manager (ISDN, n.e.), assistant to the president, The Vanguard Corp., Van Nuys, Calif.

Lockheed, Menlo Park and Space Division, Sunnyvale, Calif., has announced the following appointments: Dr. Weyland C. Galt, Sr., assistant director of research; Robert H. Gibson, production and service manager; Robert H. Gibson, production and service manager; Robert H. Gibson, production and service manager; Robert H. Gibson, production and service manager.

## Thank You, Again...



RICHARD WHITE  
2ND AVIATION BRIGADE  
JULY 20, 1958

for the biggest  
sales year in  
the history of



AVIATION WEEK, December 29, 1959

## CORPORATE LONG-RANGE PLANNERS



Aerquip-General Corporation, builder of radar engines, missile and space systems, anti-submarine warfare systems, and radar systems, has established in Corporate Long-Range Planning Division in Monterey, California, a coastal community 125 miles south of San Francisco. The site has been selected as desirable from the personal standpoint and best adopted to imaginative, constructive professional work.

The compact group of specialists constituting the Long-Range Planning Division develops courses of action directed toward continued corporate growth. A few exceptionally well-qualified individuals are needed to complete the group. Those selected will possess the capacity for independent, imaginative thinking and demonstrated broad experience in one or more of the following areas:

Interpretation of military requirements, based on specific understanding of the problems confronting the military services and of the process by which requirements are translated into systems and techniques.

Application of operations research techniques to military and non-military situations, resulting in determination of optimum course of action from both corporate and customer points of view.

Study and application of economic factors to national and corporate problems.

Application of engineering management techniques to problems of corporate organization and procedure, particularly as they affect growth and marketing patterns.

In great depth and breadth, the evaluation of new concepts in most military requirements and the application of current scientific advances to modern technological problems.

Development of advanced concepts, using graphic and other aids to achieve understanding and appreciation of complex situations and interrelationships.

Detailed resumes are solicited only from exceptional individuals with demonstrated attainments. Salaries will be commensurate.

Write: Aerquip-General Corporation, Director of Scientific and Engineering Personnel, Box 295F, Azusa, California. Attention: L. L. Thompson.

